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OIL WORLD

TWICE MONTHLY
SECOND ISSUE
MARCH, 1944

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March 30th, 1944
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Pemberton Airs Views on the "Oil Situation"

J. R. Pemberton, who used to be California oil umpire, but who has now retired to the comparative peace of a consulting business in Los Angeles, reappeared in the role of after-dinner speaker at the A. P. I.'s West Coast Spring Meeting on March 23.

Billed to speak on "What Shall We Do About the Present Oil Situation in California?" Pemberton mixed bawdy humor with Rabelaisian wise cracks about government inefficiency, PAW's District 5 personnel, and shortcomings of the oil industry itself. In a moment of seriousness he came out in support of a State oil control law for California.

Pemberton probably did not intend his speech to be impressive, but it was, the audience seemed to think, quite good entertainment.

"The only thing the government can do efficiently," he told his audience of 1000 oil men, "is carry the mail." He said that as far as the oil industry is concerned, the government has done nothing for the industry that it could not have done better itself. The PAW, Pemberton said, was formed presumably to help the industry, and it had done a good job when there was a shortage of materials. Now, there is no longer a shortage of materials, and "we don't need the PAW any more."

"Yet the District 5 staff is larger now than in the early days of the war," said the state's ex-oil umpire. "Every time I meet a friend I haven't seen for some time he tells me he's working for the PAW. If any of you want a job, go over to the PAW——they'll give you one."

"How much do they pay?" somebody called out.

After the war, Pemberton said, the PAW is going to take over the oil business in California. He warned his listeners they would have to band together to keep the government "from muscling in".

He declared that the government —using the war as a smoke screen ——"is already in the oil business in a big way," and referred to the Canol project, the proposed Arabian pipe line, the $30,000,000 appropriation for Point Barrow oil development in Alaska, and a like appropriation for oil shale and coal hydrogenation projects. He reminded his audience that the government owns the Big Inch and Little Big Inch pipe lines and that "it has in mind to use them in competition with the oil industry after the war."

Turning to the oil industry itself, Pemberton said, it had a few faults of its own. To illustrate the industry's inability to get together, he pointed to the failure of oil operators in the Belridge field to agree on a unit plan after many months of negotiation "because each one wants just a little more than the others think is his just share."

"They can't even get together in the Belridge field where production is only 5000 barrels a day and the field is almost played out," he said.

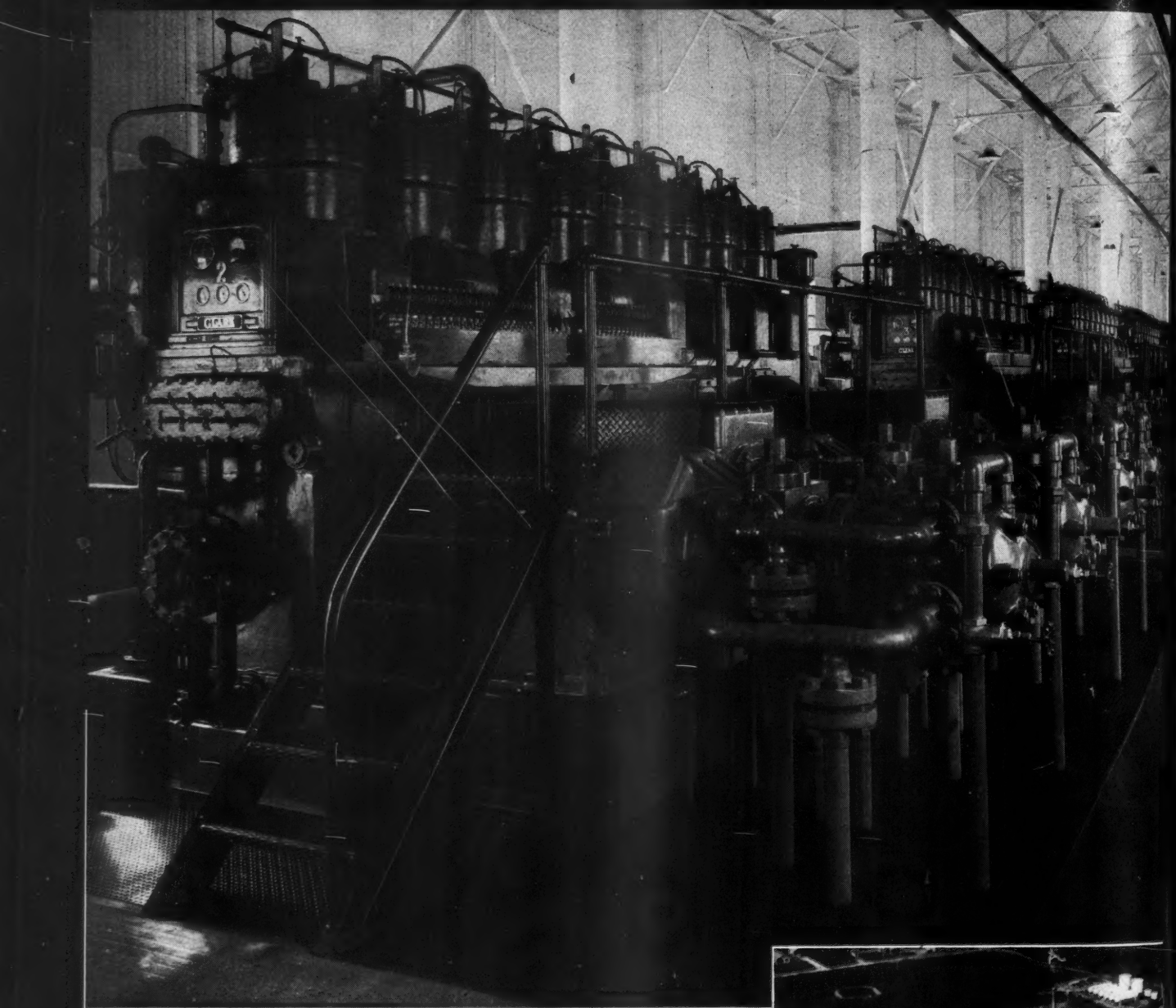
"Now, what should we do?" Pemberton asked.

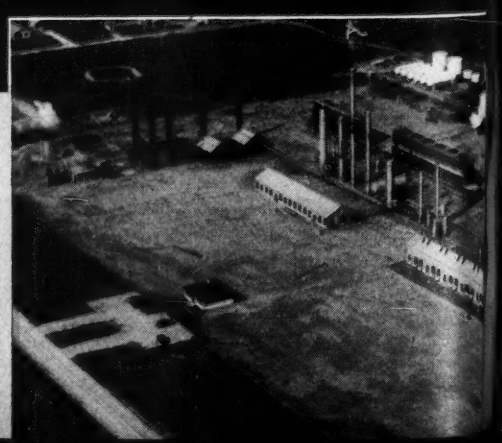
"The oil industry must get together—and it hasn't at all. We should have a state oil control law."

(Pemberton, it may be recalled, told the Cole Committee in 1934 he favored Federal oil control; then, five years later, testified he was for voluntary control.) He referred in his A. P. I. speech, to the failure of previous attempts to put oil control laws on the statute books, but said the legislation wasn't very good anyway and was unsuccessful "maybe because the wrong people backed it."

The speaker was introduced by Carlton Beal of the Richfield Oil Corp., retiring chairman of the A. P. I.'s Pacific Coast District.

A WORLD'S





Carrington King

Reports From Washington

Events of far-reaching importance to the California oil industry continue to bubble up from legislative and administrative quarters in Washington, as numerous long-waited showdowns on foreign oil developments, the problem of crude prices and other matters appear scheduled for the end of the month and the first part of April.

March "came in like a lion," as far as the industry is concerned—with the uproar over Petroleum Reserves Corp.'s suggested Saudi-Arabian pipeline. Washington observers have the uncomfortable feeling it will shatter an old, established tradition by NOT going "out like a lamb."

The exhaustive investigation of the petroleum industry, promised by a super-committee comprising 11 influential members of the Senate, is likely to start before the end of this month. The House Naval Affairs Committee is on the verge of delving into the touchy subject of Standard of California's position in the Navy's Elk Hills Reserve, and a recommendation from the Office of Price Administration—for a subsidy program that will cost taxpayers from $50,000,000 to $75,000,000 a year to encourage production from stripper wells—is on its way to Economic Stabilization Director Fred M. Vinson.

These are only a few of the matters that the industry must add to its growing list of worries. Midway in the month, came another blow to the West Coast—when A coupons in all states west of the Alleghenies were cut from the equivallent of three gallons of gasoline a week to the two-gallon ration that exists in the East . . . The five Pacific States of California, Oregon, Washington, Nevada and Arizona, were called upon for a further sacrifice by Price Administrator Chester Bowles, who sliced the 460-miles-per-month allowed holders of B coupons to 400 miles.

The important question of whether Standard of California and the Navy Department are to be permitted to legalize their "business partnership," under which the oil company is operating its holdings in the Elk Hills Reserve, still remains unanswered. Some progress has been made, however, toward an airing of the issue before the House Naval Affairs Committee.

Legislation authorizing the Secretary of the Navy to enter into a contract such as Standard and the Navy Department are seeking at last made its way to the Capitol—where Sen. David I. Walsh, chairman of the Senate Naval Affairs Committee, introduced it on March 13.

This occasioned some surprise among those who had expected the bill to be dropped in the hopper by Chairman Carl Vinson of the House Naval Affairs group. The House committee has shown considerable interest in the Elk Hills matter and it was naturally supposed Vinson would promptly introduce the legislation in the Lower Chamber, before a companion measure was introduced in the Senate.

Although, at this writing, the bill has not yet been introduced by Vinson, it is believed he may be planning on announcing a hearing date—simultaneous with the measure's introduction.

Meanwhile, Secretary of the Navy Knox has sent a letter to Speaker Rayburn, asking for the legislation and also proposing a bill to permit Navy acquisition or condemnation outside both the Elk Hills and Buena Vista Hills reserves in Kern County, but within the same geologic structure. Knox said the Budget Bureau had told him that such legislation "would be in accord with the program of the President."

While many other pressing oil matters are on the fire, the Elk Hills situation warrants considerable attention from the California oil industry. Whatever disposal is made of Standard's holdings will have a far-reaching effect on future policies regarding private holdings within Government-owned reserves.

According to Rep. Alfred J. Elliott—Tulare Congressman who is actively urging adoption of the unit plan contract—there has been a considerable relaxation, among members of Vinson's committee, of the

Arabian American Oil Company camp at Damman Dome in eastern Saudi Arabia. In the right background is Damman Dome No. 2 well. The company is jointly owned by Standard of California and the Texas Company.

former attitude of uncompromising opposition to the Navy-Standard agreement. The big, outspoken livestock owner predicts there will be "a lot of members who won't vote for condemnation."

One major factor in this asserted change-of-mind is the realization that oil from the Elk Hills area is badly needed for the war effort. Although many members of Congress do not see eye to eye with Petroleum Administrator Ickes, it is difficult to believe that Icke's formal request for an immediate increase in production from the Elk Hills field to 50,000 barrels daily can be overlooked by the Naval Affairs group. If Ickes is given the backing of the Joint Chiefs of Staff, it is a foregone conclusion the committee will think twice before recommending Government condemnation of the properties.

Standard officials in Washington —who have been waiting anxiously for a decision for months—were heartened by a report the Department of Justice has okayed the legislation permitting the Secretary of Navy to do business with private companies in the Naval Petroleum Reserves.

Asked by the Navy to look over the bill and see whether it accomplished all it was intended to, Justice Department officials are said to have approved the measure . . . Quite a change from the days last summer, when Asst. Atty. Gen. Norman M. Littell played the role of inquisitor at hearings held by the House Public Lands Committee on the same matter.

Too much optimism on the part of Naval officers and Standard officials who hope for consummation of the contract is not warranted, however. The argument over whether to approve a business relationship between the two parties or to condemn the lands outright will flare again at the hearings—especially if the "big company baiters" are given their day in court.

In this connection, Rep. Jerry Voorhis, of San Dimas, seems prepared to stake his political future on battling Standard. But Voorhis' latest blast at the company revealed the young New Dealer as an advocate of Government participation in the oil industry — particularly with regard to the Middle Eastern area.

American welder and Arabian helpers working on tank lines in eastern Saudi Arabia. Oil operations in Saudi Arabia are being conducted by Arabian American Oil Company, jointly owned by Standard of California and the Texas Company.

Urging condemnation of the Elk Hills properties, Voorhis attacked Standard for being anxious to get into partnership with the Navy in the operation of the Kern Country reserves while, at the same time, the company "has consistently refused to permit the Government to purchase any interest in its Saudi Arabia leases."

Political reaction to this comment will be interesting. While numerous Californians residing in the 12th District presumably approve the attitude of their representative toward Standard, public sentiment seems generally against Government encroachment on private enterprise.

Voorhis usually is referred to in the Eastern press as the member of Congress who "first disclosed details" of the original Navy-Standard contract . . . Actually, credit for the discovery should go to Rep. Harry Sheppard, of Yucaipa, who —as chairman of the House Naval Appropriations Committee — came across a Navy Department request for an appropriation with which to meet the terms of the contract early last year, and raised the veil of secrecy in which the agreement had been shrouded since its inception in Nov., 1942.

An interesting side-light on this is that Sheppard—soon after questioning the contractual proposals in the agreement—was approached by a group of California politicians who urged him to run for the Senate on an anti-Standard platform. He replied, however, that he was "not interested" in capitalizing upon his committee post; was neither pro- nor anti-Standard, and would not care to campaign on such an issue . . . The politicians, by the way, were not oil men.

One factor which may hold up the Elk Hills and other important oil hearings is the fact the Easter recess is approaching and that Congress is particularly weary this year. While members occasionally agreed to meet in committee during holiday recesses—in the days when few matters of national importance were on the books—it is considered unlikely there will be many recruits for overtime work in the coming Easter respite.

Here are some thoughts the California oil industry might consider in its spare moments:

Some oil experts, who are doing a lot of worrying about the postwar position of the industry, foresee a period of near-chaos for California when the military demand for petroleum products is suddenly cut off

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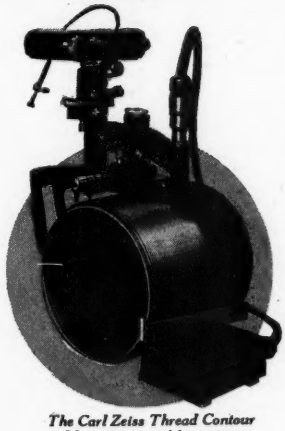

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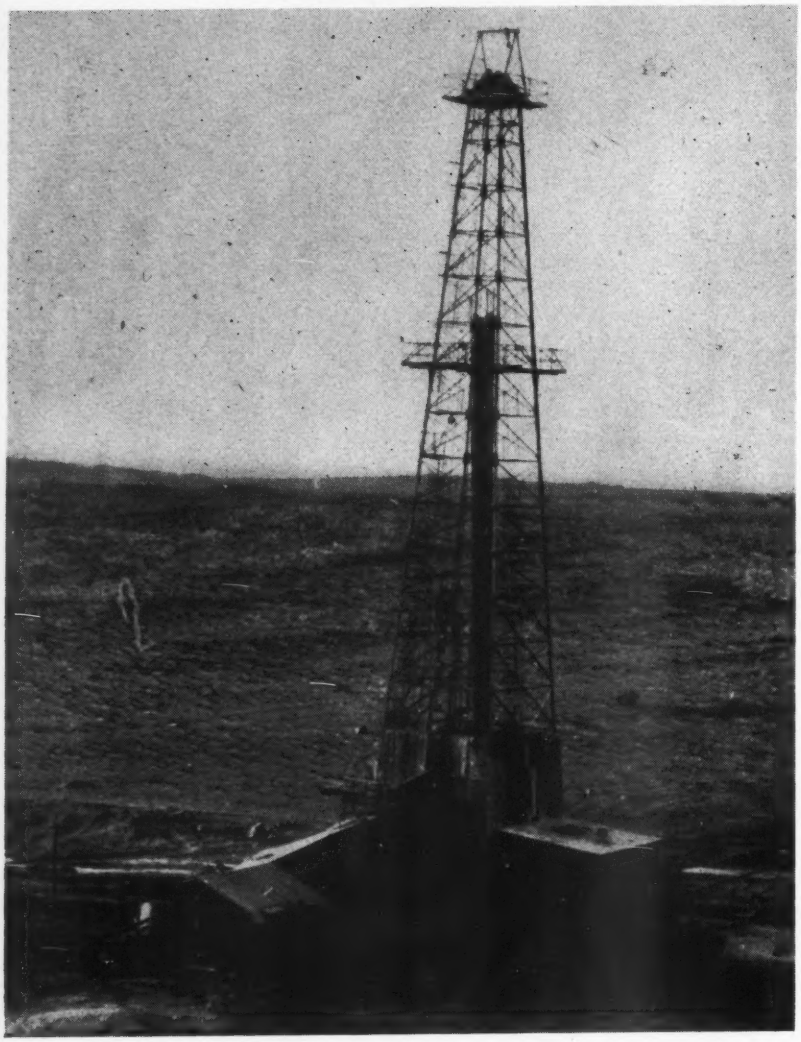

Arabian American Oil Company's discovery well Damman Dome No. 1, opened up oil fields in eastern Saudi Arabia when it tapped Bahrein zone sands January 17, 1938. The well was originally drilled to 3203 feet and then plugged to 2369. Arabian American is jointly owned by Standard of California and the Texas Company.

. . . When the war is over, the present oil shortage will be over (temporarily, at least) and the state will be floating in oil.

In the interval between the declaration of peace and the day when American industry has completed the conversion from war production to the production of civilian goods and luxuries, there will be "an awful lot of gasoline" in California, and elsewhere, and a limited market, CALIFORNIA OIL WORLD was told.

Regardless of talk about the quantities of oil that will be needed to fuel peacetime automobiles and airplanes; conversion of home-heating plants from coal to oil and the need for oil products in the manufacture of plastics, synthetic rubber and other war-stimulated products, these sources predict a surplus of petroleum for the "short-term postwar period."

In other words, when 1000-plane raids no longer are being made on Europe, and the tremendous stocks of oil and gasoline now sustaining the mechanized armies of the United Nations and our far-flung Naval units are turned back for civilian consumption, there simply won't be a sufficient peacetime demand for oil products to absorb the "demobilized" petroleum. This condition is expected to continue until postwar production of new automobiles, machinery and other fuel-consuming equipment has gotten well under way.

California will be particularly hard-hit, it is feared, because its prewar export market will be lost. A return to the old problems of overproduction may be expected, unless some sort of machinery is set up to neutralize the sudden plugging-up of production within the state.

Passage of State regulatory legislation—or even Federal conservation laws—is considered a likely aftermath of the war. The impression received by this writer was that the industry is not giving sufficient thought to the problems which will confront it when the war is ended and that—for this reason—a panicky appeal will be made to the legislature to control production, fix prices and take other measures against a temporary collapse.

About the only bright spot seen by the students of postwar petroleum problems for California was an improvement of storage conditions. Tanks now nearly empty can be replenished after the war from the plethora of oil products coming from the present stepped-up production and the vast expansion of refining capacity, it was pointed out.

Prices? The OPA recommendation for a subsidy for stripper well producers is en route to the Office of Economic Stabilization—which means the public will have to wait until Stabilization Director Vinson can study the proposal and pass upon it.

Oil men are virtually unanimous in opposing such a program. They argue it will prove cumbersome and unworkable; will encourage drilling for Government premiums, instead of oil; will not give the overall relief that would be gained from a general increase in crude prices and will subject the industry to something to which it is traditionally opposed.

The OPA program is understood to leave present ceiling prices for oil undisturbed. Operators of low-yield stripper wells, however, would have their higher operating costs covered by subsidy payments based on percentages of present ceilings.

Officials at the price agency admitted the subsidy plan "won't touch" other distressed branches of

the industry, but insist that aid to stripper well producers will solve one of the industry's major problems. They stressed the fact OPA is "merely complying with the request" of Judge Vinson, in submitting the proposal, and stated the administration of the program and the source of funds for subsidization will have to be decided by Vinson's office.

. . . Meanwhile, sponsors of the Disney bill—through which a crude price increase would be authorized by Congress—still are hopeful of Senate action in the near future. The measure, passed by the House, is pending in the Senate Banking and Currency Committee.

Six of the Navy Department's best technical men have left Washington for the Navy's great, untouched petroleum reserve at Point Barrow, Alaska.

The one-man campaign of Rep. Norris Poulson, of Los Angeles, to stir up interest in the 35,000 square miles of promising oil territory—first reported by CALIFORNIA OIL WORLD—has progressed sufficiently to cause the Navy Department to send a "preliminary reconnaisance group" to the area to study the potentialities of the reserve and to estimate the housing, transportation, provisioning and other needs for a projected opening of the reserve.

The expedition, led by Lieut. William T. Foran, will report back to Washington in approximately a month—after which plans will be made to send geological and drilling crews to Pt. Barrow, if the experts advise drilling some test wells.

Controversy over the Petroleum Reserves Corp., the Saudi Arabia pipeline and related subjects, has reached the point where it is no longer possible to keep up with the barrage and counter-barrage of questions, criticisms, predictions and "viewings with alarm."

Some clarification of the whole, vast picture of Government and industry foreign oil ambitions may emerge from the special Senate investigation now being prepared. Until the facts are sorted and the various warring factions have been given a chance to cool off, the public will continue in its present confused state of mind—trying to make sense out of a jumble of politics, inter-industry rows, Congressional punch-swapping and other side-shows attending the presentation of our alleged "oil policies."

The highly-glamorous possibilities entailed in the fact that America is looking with exceptional interest at the oil fields of the Middle East were not overlooked by the columnists and special writers of the country. It is doubtful that very many Washington correspondents remain who have not, in the past few weeks, become oil experts.

All the elements of a good story are there: Government participation in private enterprise; monopolistic intentions of the big oil companies, with holdings in the area; our international relations; the effect of the construction of the proposed pipeline on the war and the problems of cost, materials, transportation.

The main trouble is that the scope of the story is so great it can be made to contain almost any extraneous ideas that a member of Congress, an industry spokesman, a Government official, or a mere newspaperman might wish to insert.

By this time, the country has been treated to so many fantastic elaborations of the issues involved in PRC and the Arabian pipeline that it would not be surprising to hear, or read, some morning that Ickes was recommending funds for a large, Government-owned magic carpet to be used either for the transportation of oil in drums or, perhaps, to carry steel and other materials to Saudi Arabia for construction of the pipeline.

One Arabian Nights series being syndicated throughout the country is devoted to speculation about the Sheiks and Princes of the Middle East, and whether or not a secret understanding has been made by the Administration for the payment of millions of dollars to the Eastern Potentates and/or Great Britain for the privilege of constructing the pipeline. (When queried about this, officials of PRC smilingly observed, "Ask Lend-Lease") . . . Other stories would lead the average reader to believe a vertiable network of pipelines had been planned — to criss-cross Arabia and, perhaps, Iraq.

Despite the uproar, there has been little change in the situation since its denunciation by the Petroleum Industry War Council early this month . . . An Anglo-American conference on "petroleum questions" has been scheduled, which may bring Britain's Foreign Minister, Anthony Eden, to Washington . . . The special Senate investigation is on the docket . . . Petroleum Administrator Ickes and Senator E. H. Moore, of Oklahoma, tangled in a radio debate on the Saudi Arabia pipeline deal . . . The industry—instead of presenting a unified front—is setting the stage for a selfish and undignified squabble among its own members.

But there's not much real news that has not already been printed.

To refresh the memories of subscribers, we'll list the top members of the Anglo-American petroleum conference—announced jointly in London and in Washington—and the 11-man Senate Committee appointed by Vice President Wallace, and let it go at that.

British members of the conference have not yet been announced. Top men in the American group are: Secretary of State Hull, as chairman, and Secretary of Interior Ickes, as vice chairman; Under-Secretary of War, Robert P. Patterson; Under-Secretary of the Navy, James V. Forrestal; Charles Raynor, petroleum adviser to the State Department, and Charles E. Wilson, vice chairman of the War Production Board.

The 11 Senators named to the investigating committee include: Sen. Owen Brewster (R.) Me., and Sen. Scott W. Lucas (D.) Ill.—co-authors of the resolution authorizing the probe. In addition, Sen. E. H. Moore (R.) Okla.—arch foe of Ickes and of the PRC-Saudi-Arabia projects—is a member.

The other eight members are: Sens. Tom Connally (D.) Tex., chairman; Arthur H. Vandenberg (R.) Mich.; Edwin C. Johnson (D.) Colo.; Francis Maloney (D.) Conn.; Joseph C. O'Mahoney (D.) Wyo.; Chan Gurney (R.) S. Dak.; Burnet R. Maybank (D.) S. C., and Robert M. La Follette, Jr., (F. L.) Wisc.

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Los Angeles
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Presented at Spring Meeting of the
Pacific Coast District of the
American Petroleum Institute
Los Angeles, California
March 23, 1944

ABSTRACT

The damaging effect on oil sands of water filtrate from drilling mud has long been suspected.

While most of the evidence comes from deep wells, the effect of this phenomena on shallow wells has been under investigation for many years. The intensification of the shallow drilling campaign in California in 1943 brought this subject to the attention of the industry and some of the results are enlightening. The effect of "water block" in shallow zones was definitely indicated in a group of wells at West Coalinga.

The use of oil base mud appears to overcome this "water block." Evidence indicates that hydrolized starch may also improve the mud quality by lowering and minimizing the water loss. Whether a low water loss is a sufficient answer is as yet unknown.

Oversized hole, caused by the action of water filtrate on shales, would indicate that this action often is prevalent in shale partings of producing oil zones. Low water loss mud should be used throughout the drilling of a well and particularly when penetrating most oil zones.

Oil is a good completion fluid if it does not affect the shale and cause it to slough and run.

Salt water is apparently less harmful to the oil zone than fresh water.

Careful attention should be given to the fluid used in completing shallow zone producers.

INTRODUCTION

In the past few years, many hundreds of wells have been drilled in California by the rotary method into zones having formation pressures as low as fifty pounds per square inch, and having permeabilities as high as 15 darcies. It may be stated that most of these were completed as producers, despite the method of drilling and the lack of pressure in the zones. Nevertheless, it may be debated as to whether higher initials could be obtained by using better completion methods and a proper fluid for drilling into the producing zone.

The majority of the wells were drilled and completed with water-base drilling fluid made from California native muds. Recently, however, considerable attention has been paid to improving the character of drilling fluids to lessen possible harmful effects on initial and settled production.

Special fluids, either to drill in with or for final completion of the well, have been used in an attempt to improve productivity. These fluids have consisted of oil-based fluids, benetonite gel fluids, and chemically treated water-base muds.

Attention was directed to the possible harmful effect on low pressure sands of too heavily weighted muds which might force mud fluid into the sands. Consequently, the use of low weight—70-75 pound fluid is now considered the proper procedure.

With the use of water-base muds, the effect on permeability of the water filtrate seeping into the sands or the formation of a "water block" were taken into account. Rapid completion following penetration of the sand may minimize these conditions.

Thought was given by some that by the time a liner is run and the well completed, the effect on production of an excessively thick and perhaps impervious mud cake occurring on the face of the sand which could not be dislodged by the low pressure formational fluid, would be excessively harmful. This might be particularly true if very fine mesh perforations or gravel pack were used unless the annulus was thoroughly flushed.

On a well completed last year two runs of the hole caliper were made, the second run being five hours after the completion of the first run. This well was drilled with a good water-base mud in a highly permeable sand. Your attention is called to the thickness of the well cake deposited opposite the sands of the producing zone in this five-hour interval. This, of course, only shows the mud cake deposited. It is no measure of the filtrate water which must have penetrated the zone during this period of deposition of wall cake. See Plate I.

WATER-BASE FLUIDS

Effect of Water on Oil Zones

From laboratory data and some field experience, it is common knowledge that water, particularly fresh water, seeping into certain sands in some way impairs permeability which may result in a decrease in oil productivity.

A well in the Signal Hill field completed in the middle of 1930 for 80 B/D average for the first month gradually built up in production until in 1934 it averaged 130 B/D for a three-month period. There was no change in the producing method employed on this well yet gradually the production built up and water block in a tight sand is suspected as the cause or reason for the low initial production.

A well at Paloma was completed in sands of low permeability with water-base mud at rather a disappointingly low rate of 34 B/D, 47.8 gravity, 360 MCF. During the succeeding weeks, production from the well rose gradually to a figure of 85 B/D, 54.5 gravity, 840 MCF, indicating an initial water block although another factor, gun-perforating, may have influenced the well's behavior.

One investigator has made laboratory tests on the permeability of sands to various fluids. The results of the experiment indicate that the permeability of a sand may be reduced as much as sixty times when penetrated by fresh water. When the fluid was changed to salt water

on a core of a similar type sand the permeability was reduced only twenty times. Two other experimenters, working independently of each other, arrived at the same conclusion, namely, that any water loss into the producing sand is harmful.

The importance of this observation is that while a little water loss is probably less damaging than a lot of water loss, it is possible that the effects of the little may be greater than heretofore suspected.

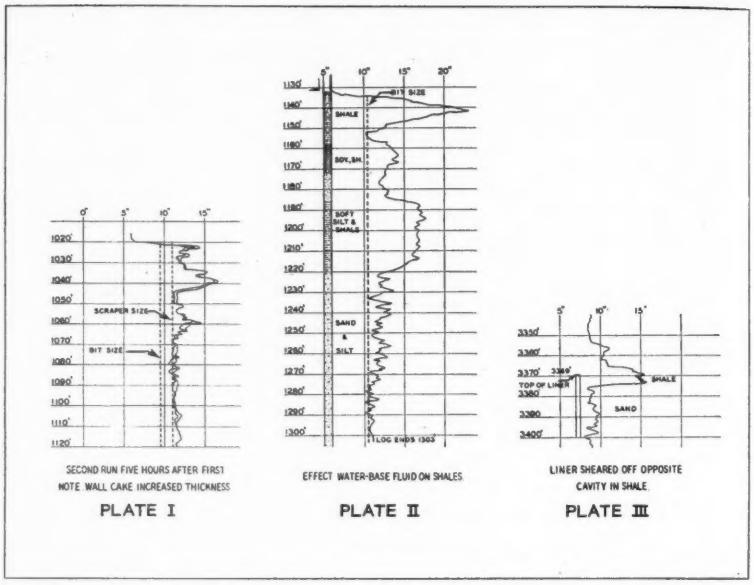
Impaired permeability may particularly occur in sands of Continental deposition, which contain ashy material or a large percentage of feldspar, together with their decomposition products, bentonite and kaolin, respectively. Some specific field experience can be cited. One well in the Mt. View Field after being completed for 1160 B/D of 21.3 gravity oil in the Chanac Zone was killed and deepened. Later, when the well was plugged back to this zone, only 106 B/D could be obtained on the recompletion in a heading flow. Another well in the same field flowing 784 B/D net oil was killed with mud and water for the purpose of plugging. Upon recompletion, the best rate obtainable was 264 B/D.

Experiments on sands in Cole's Levee, which contain a high percentage of feldspar, have shown a great decrease in permeability when fresh water has been pumped through them for a number of hours.

Experiments in the North Cole's Levee Field and the Wilmington Field have indicated a few examples that production rates are lower upon recompletion after wells have been killed with water.

The Temblor Sands at Kettleman Hills often lose their productivity when exposed to formational waters, necessitating redrilling operations to bring the wells back on oil production.

A Dominguez Field well was completed as a 4000 barrel producer. Owing to a leak in the tubing head, it was necessary for the operator to kill the well to change this connection. The well was killed with water. When recompleted, the productivity index was much less than on the original completion, and although the well improved over a long period of time, it never regained its original productivity.



In the recompletion of some damaged wells an operator found that the recompletions were as good or better than the original completions. The operator attributes this to the short time interval the sands in these wells were exposed to the drilling fluid while recompleting.

At Signal Hill a DeSoto Zone well was completed with a conventional liner and the well was swabbed for thirty days. During this period, over 600 barrels of fluid, mainly salt water, was recovered from the interval opened. This recovered water was tested by the laboratory and traces of phosphate used in the drilling mud were detectible at the close of the thirty-day period. While this is not a large volume of water, the presence of the phosphates definitely indicate that the water from the drilling fluid had invaded what should have been the producing zone.

Effect of Water on Shales

Numerous runs of the hole caliper have shown that use of water-base mud causes beds of shale and clayey silts to run, in some cases, and to gradually slough off in other cases, to such an extent that the actual hole size opposite those formations may be twice the diameter of the bit size.

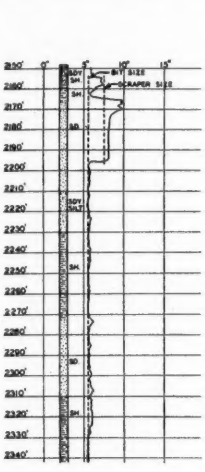
Plate II shows a caliper log run immediately after cleaning out the hole following the setting of the casing.

We have considerable reason to believe that the shales already soaked with drilling water continue to run some time after the liner is in place and the well is on production. Moreover, if there is considerable annulus between liner and the sand bodies, the shale will tend to pack between the sand and the liner and wholly or partially shut off production or collapse liner. This may account for the rapid decline in production often seen in low pressure zones.

A well was completed in the Redondo Field in July, 1936, with Grade D pipe. Within a few days after the completion of the well, on which the initial production was 161 B/D, the liner collapsed and production dropped rapidly to a 50 B/D rate. In the fall of 1943 it was decided to pull this liner and rework the well. Plate III shows a caliper log of this well. The top of the collapsed liner was recovered from a depth of 3369 feet. The reason for the collapse is more or less obvious from the hole caliper run. The 15" diameter hole at this point indicates that the unsupported wall of the hole collapsed against the liner and sheared it at 3369 feet.

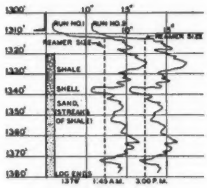
Crude Oil and Oil-Base Drilling fluids

In view of the detrimental effect of water on some formations, as indicated in the laboratory at least, a few operators have resorted to various types of oil-base drilling fluids or



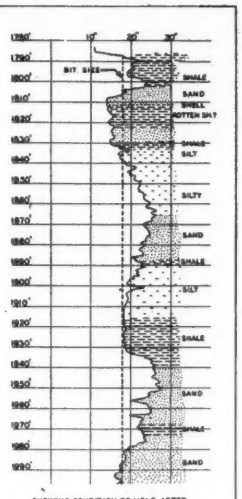
EFFECT OIL-BASE FLUID ON HOLE SIZE.

PLATE IV



FILTER-CAKE VS TIME OIL BASE FLUID

PLATE V



SHOWING CONDITION OF HOLE AFTER PULLING LINER FROM PRODUCING WELL.

PLATE VI

plain crude oil for drilling in the zone. In addition, in case of oil-base fluids, there is some thought that a cake is formed which is thinner and less tough than a water-base cake, and is easily miscible in the formational fluid.

Caliper runs show that very little formation, especially shales, slough off into the hole when using one type of oil-base fluid. Plate IV shows a caliper log on a well drilled in and partially wall scraped using this same type of oil-base drilling fluid. Note that the shales have sloughed but little although the loose part of the sand washed out during the scraping operation.

Moreover, experience on one well, at least, shows that there is no measurable build-up of cake with oil-base mud when standing in a well for the period of time necessary to run a liner and commencement of bailing operations. This is shown by examination of Plate V. On this plate, Run No. 2 was made after the well had stood for thirteen hours.

Instead of oil-base drilling fluid, many operators have completed wells or attempted to, by either drilling in with crude oil or by drilling in with water-base fluid and wallscraping or washing with crude oil.

This has been successful in a number of areas. In others, however, some types of shale begin sloughing very badly when the oil comes in contact with them and in some instances hole conditions becoming so bad that it was impossible to run the liner without changing the drilling fluid. In some areas which contain shale affected by oil, it is probable that the shale continues to slough into the hole behind the liner after the well is on production, and may have the same effect as noted above, namely, that the well rapidly enters the stripper class. This condition would be aggravated by producing sand from the well which would tend to form a cavity in any sandy body under shale. The shale would then slough from above the sand body into the cavity and partially or completely shut off production. The caliper log shown on Plate VI indicates that such a condition may exist. The well shown on this Plate was completed in a sand-shale section several years ago in the Kern Front Field. During its production history, the well made varying amounts of sand. Recently, the liner was pulled and a caliper was run as shown. From the log it is seen that in two cases the shale had broken away above a sand cavity and presumably back-filled the annulus opposite the sand bed.

The authors have only two suggestions to prevent such packing of shale behind liners. In those areas containing shale which is not affected by oil, the wells should be drilled in with crude oil or oil-base drilling fluid. In areas where shale is affected by oil, either drilling oil or formational fluid, the best solution appears to be a conventionally gravel-packed liner regardless whether or not sand conditions are bad.

Solid cementing and selective gun-perforating may also solve the problem, but this method is believed applicable in low pressure zones only in selected areas.

Other Drilling Fluids

Besides ordinary water-base mud and various types of oil-base drilling fluid, two other drilling fluids can be mentioned. Some operators prefer to drill in or freshly wall-scrape low pressure zones with the drilling fluids made from bentonite. This fluid makes a very lightweight mud which reduces the hydrostatic pressure against the zone and is believed to form a soft, easily removed cake. However, some laboratory experiments have shown that a bentonitic gel cake on sands of high permeability may be inadequate to prevent actual penetration of the gel into the zone. Whether or not this is detrimental, is not known.

A second completion fluid very recently tried consists of water-base mud of a high alkaline value treated with hydrolized starch. This combination is said to have the effect of greatly lowering the water loss and forming a very thin cake, thus both decreasing the seepage into the sands of drilling water and eliminating any harmful effect due to the presence of a thick tough cake. It may have promise, especially if salt water is used as the mixing medium.

Effect of Various Fluids on Production

Considerable data indicate that the presence of water, particularly fresh water, is detrimental to the effective permeability to oil of many sands, especially those of low values. This condition, of course, would seriously impair production from low pressure zones. Therefore, it would seem logical that such zones should be drilled with some fluid other than water-base muds. Wells drilled with these other drilling fluids should therefore show improvement in production over those drilled with water-base mud. However, it is extremely difficult to prove this in the field. In most fields in California, and particularly in the San Joaquin Valley, the

(Continued on Page 33)

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Stuffingbox for Refinery Pumps Packing vs. Mechanical Seal

By A. HOLLANDER
Consulting Engineer of
Byron Jackson Company

(Presented to California Natural Gasoline Association Monthly Meeting, Rio Hondo Golf Club, Downey, California, February 3, 1944.)

Except for a few special units, of which I shall speak later, the rotating shaft of all centrifugal pumps has to come through the stationary casing into the atmosphere in order to be coupled with the driving motor, turbine or engine. The parts of the pump, which prevent the pumped liquid to escape into the atmosphere, are called the stuffingbox. As a rule, we are satisfied with limiting the leakage instead of preventing it. This leakage limitation can be done by providing a cylindrical body closely fitting the shaft, which is the old accepted and mostly used **standard stuffingbox.** The cylindrical body is generally formed by a pliable packing pressed into the ring recess by the gland. The leakage path in this case is a long, narrow cylindrical slot, through which the flow is pretty near always laminar. The alternate scheme for the reduction of the leakage is to have in close contact two discs, one of which is stationary and tight within the housing and the other is fastened to the shaft and is rotating; this is called a **stuffingbox with mechanical seal.** Conical surfaces were suggested but found unsatisfactory, as well as labyrinth paths, which, while adding complications in construction, do not bring the advantage as they do for air or steam, because with liquid there is no expansion from one chamber to another, only the loss of the velocity head in the different chambers.

While for a long time, only the stuffingbox with pliable packing was used, lately the mechanical seal is finding wider acceptance in new applications so that a comparative examination of the two schemes seems desirable.

As a first step, to clear up the difficulty of the packing problem, it should clearly be specified what is the **stuffingbox pressure** as differentiated from **packing pressure.** In some pumping installations, the liquid enters the pump at a pressure slightly above atmospheric, so that if the stuffingbox is on the suction side, it has to be packed only against this low suction pressure, which is the stuffingbox pressure and also the packing pressure. For multistage pumps one end may be suction pressure, the other end a higher pressure, e.g. first stage on the pipeline pump, so that this second stuffing box would have to be packed against a higher pressure. In such pumps the higher pressure is in most cases throttled down to a lower pressure in the inner end of the box and the leakage led back from a cage ring to the suction. (Fig. 1.)

If the **throttling** is done **by a solid bushing** up to the cage ring, which, due to bleeding back, is under suction, then the packing pressure is suction pressure. On the other hand, on some pumps the throttling from inside the pump to the cage ring is done by plastic packing, in which case the packing pressure on the packing between the pump and the cage ring is the difference between the first stage pressure and the suction pressure, while for the packing

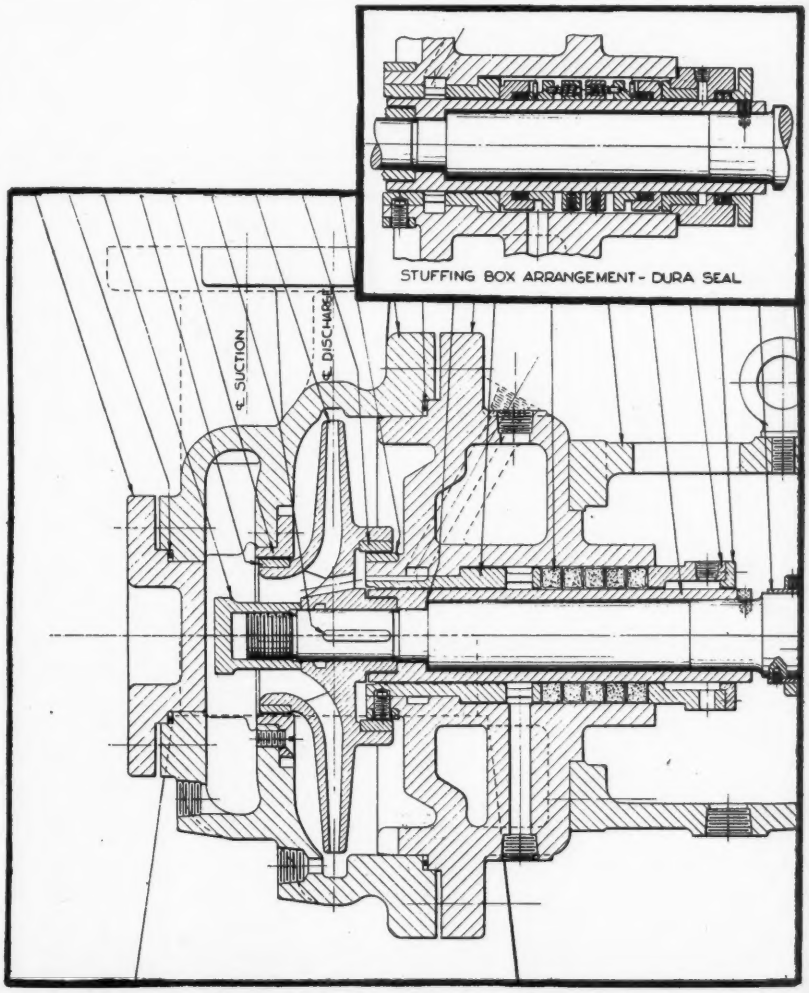

Fig. 1 Refinery Process Pump, showing stuffingbox with throttle bushing to a leak-off or sealing point, followed by pliable packing. Insert shows the same stuffingbox with double mechanical seal (Duraseal). The gland has a two ring pliable packingbox for safety in case the mechanical seal fails.

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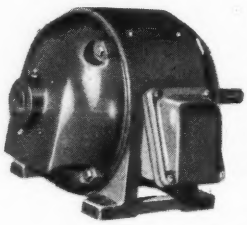

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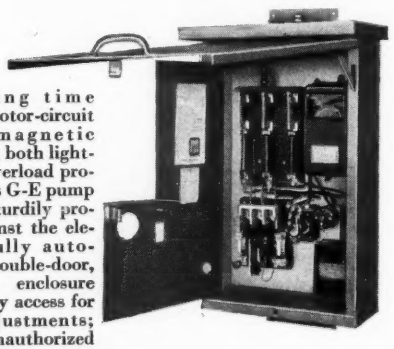

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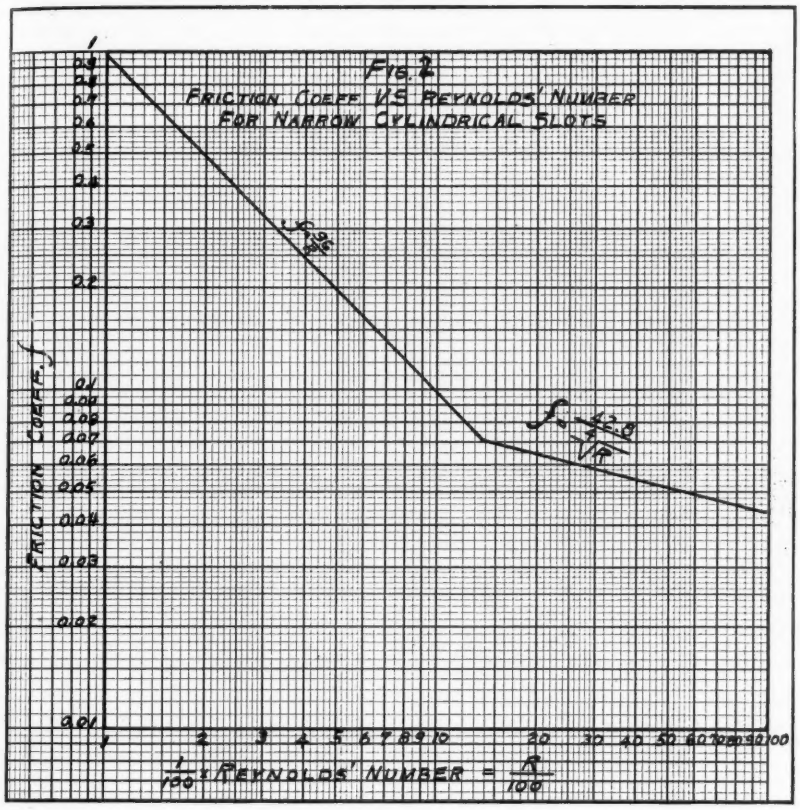

Fig. 2 Friction Coefficient vs. Reynolds Number for narrow cylindrical slots.

between the cage ring and the outside, the packing pressure is the difference between the suction pressure and the atmosphere. This is equally true for plastic packing and mechanical seals and it would be very desirable if manufacturers publishing performance data would give either complete data, or a clear statement of stuffingbox and packing pressures. To claim that a packing or seal works against a pressure of 400 psi because that is the pressure within the pump next to the stuffingbox, when that pressure is throttled by a bushing to 25 psi and the leakage bled away, is definitely a misstatement, because the packing or seal is actually working against 25 psi pressure.

Naturally any leakage bled back to a lower pressure is a power loss, but this is already included in the guaranteed brake horsepower and the user has only to compare designs to determine, whether this loss does not increase greatly during long operation. The possibility of reducing it at any time by repacking is the justification for the use of pliable packing in some cases.

Actually both a solid bushing and the pliable packing provide a long **cylindrical slot,** which limit the leakage by making the clearness, forming the slot very small. While the leakage flow between bushing and sleeve is in extreme cases turbulent, in most cases it is laminar; for either case good experiments and theory are available to figure it, particularly for stationary (non-rotating) condition, which gives a higher and therefore safe value for the actual conditions, when the shaft is rotating.

In order to have comparable data with pipe flow formulas, the **Reynolds' number,** which for the latter is referred to the pipe diameter, is referred to the diametral clearance, both being four times the hydraulic radius.

$$R = \frac{aV}{v}$$

R = Reynolds' number
a = Diametral clearance
V = Velocity thru the slot
v = Kinematic viscosity

If the units are consistent, e.g. all in inch and seconds, then the Reynolds' number is nondimentional.

If Q is the flow rate, then the Reynolds' number can be written:

$$R = \frac{2}{\pi} \frac{Q}{Dv}$$

This shows that for liquids of the same viscosity the flow divided by the diameter is the significant parameter, independent of the clearance; the only point to note is that for the same value of $\frac{Q}{D}$ the value of Reynolds' number for pipes (R_p) is twice as big as for slots

$$R_p = \frac{4}{\pi} \frac{Q_p}{D}$$

Therefore comparing pipes and the small cylindrical slot between shaft and stuffingbox bushing if the flow should change from laminar to turbulent at the same Reynolds' number, it will do so at half $\frac{Q}{D}$ value for pipes as compared with slots.

Continuing with consistent units in case of laminar flow and designating:

W = Weight flow
g = Gravitational constant
L = Length of slot
p = Pressure drop

The weight flow can be expressed:

$$W = \frac{g}{96} \frac{p}{L} \frac{Da^3}{v}$$ for the slot

as against

$$W_p = \frac{g}{128} \frac{p}{L} \frac{D^4}{v}$$ for the pipe

Note the difference in the constants, even though the velocity distribution through the section is in both cases parabolic.

Finally taking the general formula for head loss (h) which is used for laminar and turbulent flow:

$$h = f_p \frac{L}{D} \frac{V^2}{2g}$$ for pipes

and $$h = f \frac{L}{a} \frac{V^2}{2g}$$ for cylindrical slots

(Fig. 2 Based on Schneckenberg, Z.A.M.M. Vol 11-1931, pp. 27-40) for the laminar region the efficient f will be

$$f_p = \frac{64}{R_p}$$ for pipes

and $$f = \frac{96}{R}$$ for cylindrical slots

An example will give some feel what these figures mean. A 3"

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shaft with 0.008" diametral clearance in a sleeve 7" long will give a leakage of about 2 GPM for cold water or liquid of similar viscosity under 400 ft. head, in a concentric position and about 5 GPM when touching at one side, that is in fully eccentric position. In laminar flow, which is the case in the example given, full accentricity increases the leakage 150%, while in turbulent flow only 25%. The same set-up under 10,000 ft. head will give in concentric position a leakage of 14 GPM, this being, of course, turbulent flow. This is the arrangement used by the Byron Jackson Co. for some pumps with high suction pressure, the largest being a pump with 6400 psi discharge pressure, running at 3550 RPM with a suction pressure of 4000 psi; a solid bushing closely fitting the shaft sleeve and a catching chamber for the leakage constitute the whole stuffingbox, without any packing or parts in contact.

From the formula of the weight flow (W) it can be seen that the leakage increases with the third power of the clearance in the laminar region, which is the one that is normally encountered. This means that by reducing the clearance from 8 to 4 thousandths, as it has proven possible in some careful set-ups, the former leakage of 2 GPM in the first example is reduced to ¼ GPM, that is a pretty low figure even for a packed pump.

With pliable packing the dimension of the cylindrical slot is indefinite, until the packing wears in and forms a truly cylindrical slot. Because the packing can give, the slot may be a great deal smaller than with solid bushing. The limitation in the reduction of the clearance between the shaft and packing is due to the deflection and vibration of the shaft in operation. Furthermore the tightening of the packing by the gland does not give a uniform compression on the packing, as the compressive force is reduced at each ring by its friction, so that the packing will be tight at the gland and gradually more loose towards the bottom of the box, therefore the clearance slot is not uniform. To reduce the friction between the packing and the walls very smooth surfaces for the sleeve and box are definitely desirable. Also it seems that, particularly with metallic foil packing, the compression of each coil individually gives best results. This can be accomplished by inserting as a packing tool, a metal ring cut in halves between the gland and the packing, tightening it, and repeating the procedure for every ring up till the last ones, these being tightened directly with the gland.

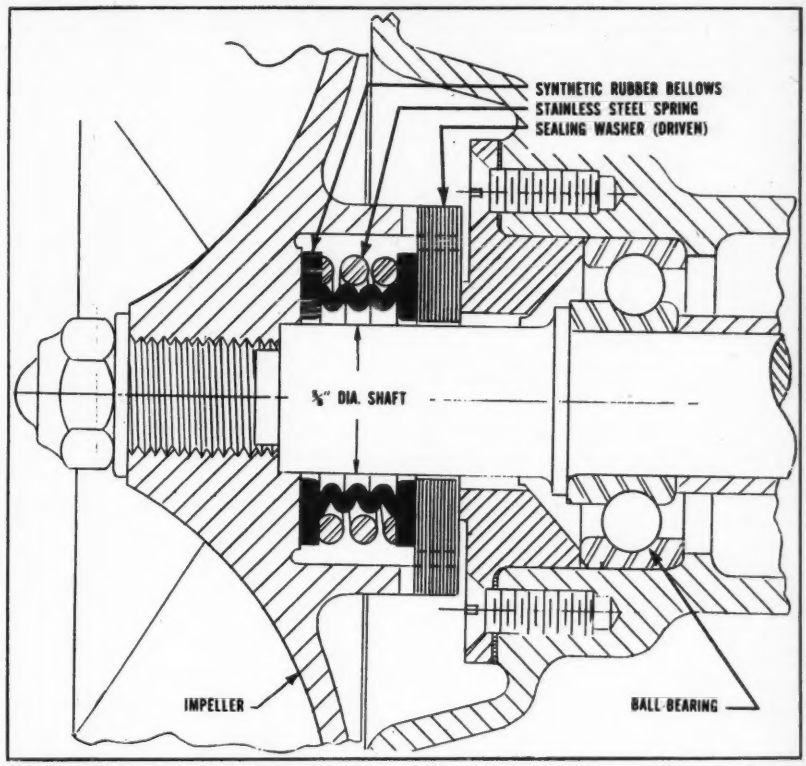

Fig. 3 Mechanical Seal (John Crane) as adapted to airplane engine circulating coolant pump.

In regard to **power consumption,** according to the latest published experiments with stuffingboxes by Mockridge of Worthington (See ASME Transactions, Aug. 1943, pages 642-3) in an ideal set-up and a shaft diameter of 3¾" and nine packing rings of ½" square, the power consumption was ½ HP per box at 1800 RPM and more than double this figure with a tightened box when the leakage was reduced to one-third of the optimum. This power loss is proportional with the square of the RPM, so that it would amount to 2 HP to 4 HP at 3600 RPM. All the above tests were conducted under a differential pressure of only 10 lbs. between the ends of the stuffingbox. While the heat generated is not great, it has to be led away and at least for the higher speed this would certainly require a cooled box or ample circulation through the cage ring.

In reference to the **packing materials,** asbestos, rubber, flax, semi and full metallic foils are available for different liquids. These packing rings are generally of square cross section and are available in coil form or cut to exact dimension to fit the shaft. They are impregnated with some lubricant which serves as such for the start, but in many cases later it is washed out or if it is soluble in the pumped liquid, it is dissolved in it. It is best therefore to rely on the leakage as the lubricant and this is the reason, why there is a minimum leakage, below which the packing will deteriorate and continuous satisfactory operation will be hardly possible. Unlike this, metallic seals are substantially tight; a drop in five minutes or in an hour is quite common in satisfactory operation.

Unlike the stuffingbox with pliable packing or with the solid bushing, which rely on long paths and relatively large clearance, the **mechanical seal** interposes a very short path, so that the leakage between the two chambers, which it separates, is prevented by an extremely

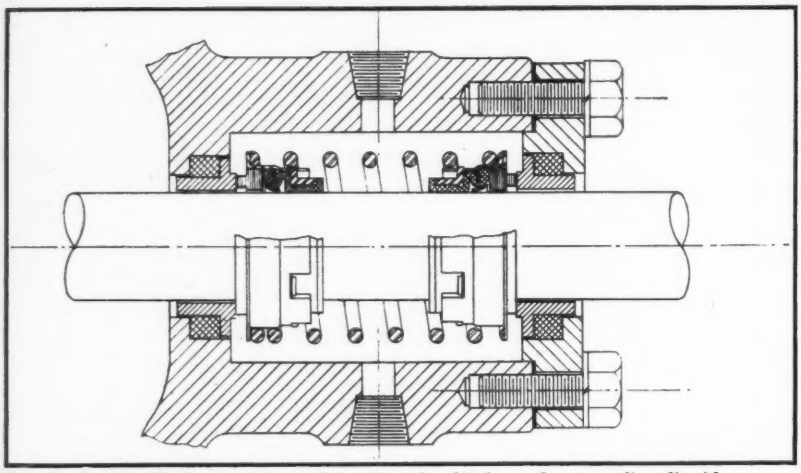

Fig. 4 Double Mechanical Seal (John Crane) with in and out sealing liquid.

small clearance space (Fig. 3). To reduce the clearance space to a minimum the two flat surfaces, which for our purpose may be called contacting surfaces, (one stationary and the other rotating) have to be much smoother, than the sleeve surfaces with packing. The length of the path is of the order of 1/16" for very small to ⅜" for large shaft seals, instead of 2" to 6" for packing. To take care of inaccurarcies of mounting, bending of the shaft and vibration at least one of the discs, generally the rotating one, but preferably both i.e. also the stationary disc, is flexibly mounted. As the stationary disc has to be mounted liquid tight against the casing and the rotating disc against the shaft, natural rubber or neoprene bellows are used wherever possible; these give the required flexibility and tightness, and also take care of wear. One of the contacting surfaces is hard metal, the other as a rule a non-galling soft metal, special plastic or graphite, the latter because of their self-lubricating quality. A light spring is used to take up wear and keep the surface in contact, when the pump is standing still. As to the amount of **wear,** one of the manufacturers tells of an experiment with a graphite disc, having about ⅛" sealing face in a small water pump, which showed 1/16" wear in 4000 hours of operation.

In reference to the theory underlying the operation of mechanical seals, if they were perfect and the liquid absolutely clean the boundary film investigations with solid discs, polished and flat better than one-millionth of an inch by Mr. Needs of the Kingsbury Machine Works (See ASME Transactions, Vol. 62, No. 4, pp 331-345) would give a very good guide. These show that there is a very strong attraction between liquids and solids near the surface up to a distance of at least 60 millionths of an inch. The surfaces have profound influence on the film, which has great mechanical strength and able to support at least 800 psi. The torque starting at a high value with greater film thickness gradually (in hours) decreases to a minimum about one-tenth its starting value and under these conditions a minimum film thickness is established. During continuous running, the torque is proportional with the RPM. The investigation shows film thicknesses down to 30 millionths of an inch and tests with 800 psi loads with 50 millionths of an inch film. The friction coefficient shows values down to 0.007 and up to 0.3 i.e. a range of 43 to 1 under different conditions, oils, loads and periods after start.

Prof. Connelly of Lehigh recognizes four different classes of conditions:

a. Dry rubbing contact, resulting in reduction of contact (abrasion)
b. Rubbing contact in presence of a lubricant resulting in reduction of contact surfaces (wear)
c. Relatively thin film separating the surfaces (as described above)
d. Relatively thick film separating the surfaces (hydrodynamic theory of bearings)

The mechanical seals operate under conditions a, b, and c, the last one under the most favorable circumstances, the first one less so because of dry contact, but on account of impurities or abraded particles getting between the faces of the discs.

Actual operation, of course, can not even approach the laboratory set-up of the viscosity meters of these experiments, and even theoretically discrepancies arise because these were made with full discs, the force being put on by outside means. We do not know any published experiments with narrow ring faces under a major pressure difference in the liquid filled chambers between the inner and outer edges, which obtains in mechanical seals. Even if they were available for ideal conditions, impurities, lack of optical faces, misalignment, vibrations are expected to result in major deviations from the ideal. Nevertheless experiments approaching theoretical and with actual pump set-ups are highly desirable and it is hoped, that they will be made and their results published at an early date for better understanding of the operation of mechanical seals.

We are advised that satisfactory operation of small seals up to 600 psi packing pressure difference was obtained in the field, although most manufacturers limit the suggested use to 400 psi maximum and less for larger seals and high linear speeds. However, most of the seals in operation are for low packing pressures; wherever possible a solid throttle bushing with a leak-off to the lowest available pressure above the atmosphere, is used to reduce the packing pressure to a minimum. The maximum temperature for seals is about 350° F but long before this is reached, the construction becomes a great deal more complicated by the substitution of metallic bellows which are harder to seal at the joint with the shaft. Similar difficulties arise when the pumped liquid is corrosive and requires special materials which are less suitable for the sealing discs than the standard parts.

In this discussion heretofore the pressure next to the stuffingbox was supposed to be above atmospheric. If it is below atmospheric, liquid of higher pressure is led to a cage ring between the suction chamber of

the pump and the gland, and is throttled in both directions with pliable packing or mechanical seal although inwards a solid bushing is generally a good solution. The same scheme is used, even when there is no vacuum on the suction, when the sealing liquid is different from the pumped liquid because the latter is hot, explosive or dangerous to health as a liquid or gas, when it gets into the atmosphere, so that its escape has to be wholly prevented. In that case double mechanical seals have the advantage, that their leakage being very much smaller, prevent the contamination of the sealing liquid much better, than throttle bushing or plastic packing.

While the sealing for water pumps is regularly dead ended, the water flowing away from the central cage ring out to the gland and into the pump through the packing slot, for light hydrocarbons or hot oil pumps, the cooling seal oil instead of being a dead end, should as a rule be flowing through, as thus it will take more heat away and as a result the box and packing will be cooler (Fig. 4). Besides cooling with the sealing liquid, pumps particularly for hot liquids, have a cooled stuffingbox housing to cool the packing (Fig. 5).

Whether one **seal oil supply** is used for each individual unit or for a number of them depends upon the conditions, particularly the pressure at the stuffingbox and the sensitivity of the process against contamination from one pump to another. This problem with other features of light hydrocarbon stuffingboxes is thoroughly discussed in the excellent article of Mr. Taylor of Lummus (see National Petroleum News of March 3, 1943, pp. R-113-116). If the pressures are substantially the same, it is simpler to use one supply, while if they are greatly different, the same supply can only be used, if the lower pressure pump seal oil line is provided with a reducing valve to bring the pressure down to the required low level. Some installations are particular enough, to have, on each pump a regulating valve for the seal oil supply, which keeps the pressure difference between the supply and the internal stuffingbox pressure constant, irrespective what the absolute values are. This is of course the ideal scheme, but it is the most expensive one.

One of the most important factors in the handling of stuffingboxes depends on whether the pump can be shut down or not, when the stuffingbox shows some irregularity or abnormal condition either in getting too warm or having too great leakage. Some systems are such that the **shutdown** involves great expense and trouble, so that it has to be avoided at all costs, while in other applications a shutdown for the replacement of the packing or seal is not objectionable. In many cases a spare unit is available which can be put on the line, when one unit makes trouble; however some very expensive double case pumps or large capacity units are often used without spares. Evidently the choice of the stuffingbox will depend on the application, as in the latter example, a construction, which permits adjustments and the completion of the run, will be the deciding factor in the selection.

Late practice, introduced by some refineries, to have special pump men, who are making regular daily inspection rounds and who are the only ones permitted to make any adjustment or repacking a pump or change the seals, is one of the most progressive steps in lengthening the life of the packing, shaft sleeve or seal. Compared with such an arrangement, pumps far out in the field, which get very little attention, should be considered as an altogether different stuffingbox problem, even when they handle actually the same liquids against the same pressure as pumps in the refineries under close supervision. Many very useful practical suggestions for the installation and operation of stuffingboxes with plastic packing under difficult conditions are found in the splendid article of Mr. Hugh Platt of Byron Jackson Co. (See Power, Jan. 1944, pp. 70-72.)

The refinery pumps are provided with different **indicating and regulating devices** for the stuffingbox, as pressure gauges, thermometers, flow rate indicators or pressure regulators for the seal oil, which are regularly checked so that adjustment can be made before greater damage occurs. These devices are of course added complications requiring a great many valves, piping, etc., which sometimes cost just about as much, as the pump itself without any frills. It is evident therefore that the particular **duty and application** of the units, including their location and whether they are subject or not to supervision, should have as much to do with the proper stuffingbox design as the hydraulic conditions including the characteristics of the liquids that are to be handled.

Comparing the relative merits of the stuffingbox with pliable packing and mechanical seal we find:

The Pliable Packing

a. Is more available and may be handled by less experienced operators.
b. The stuffingbox may be packed with it by withdrawing or removing only parts

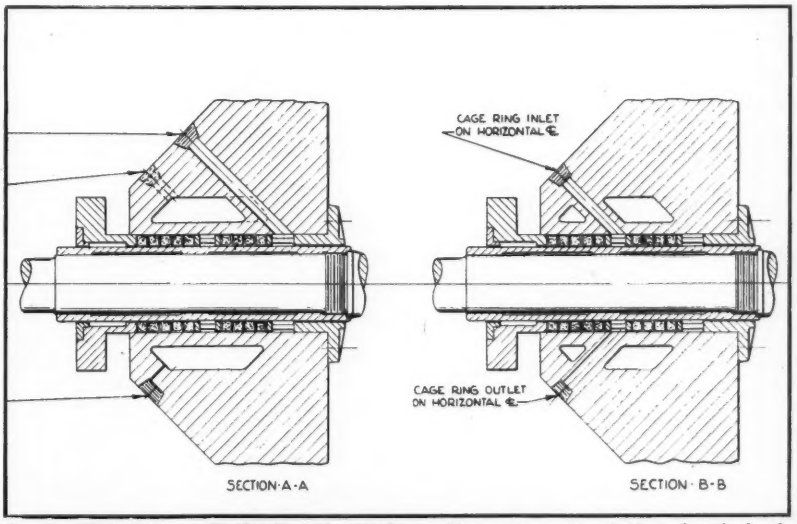

Fig. 5 High Pressure Stuffingbox for pliable packing with cooling jacket, throttle bushing to a bleed-off followed by packing to a sealing liquid cage ring with in and out connections, and another set of packing tightened by the heavy gland.

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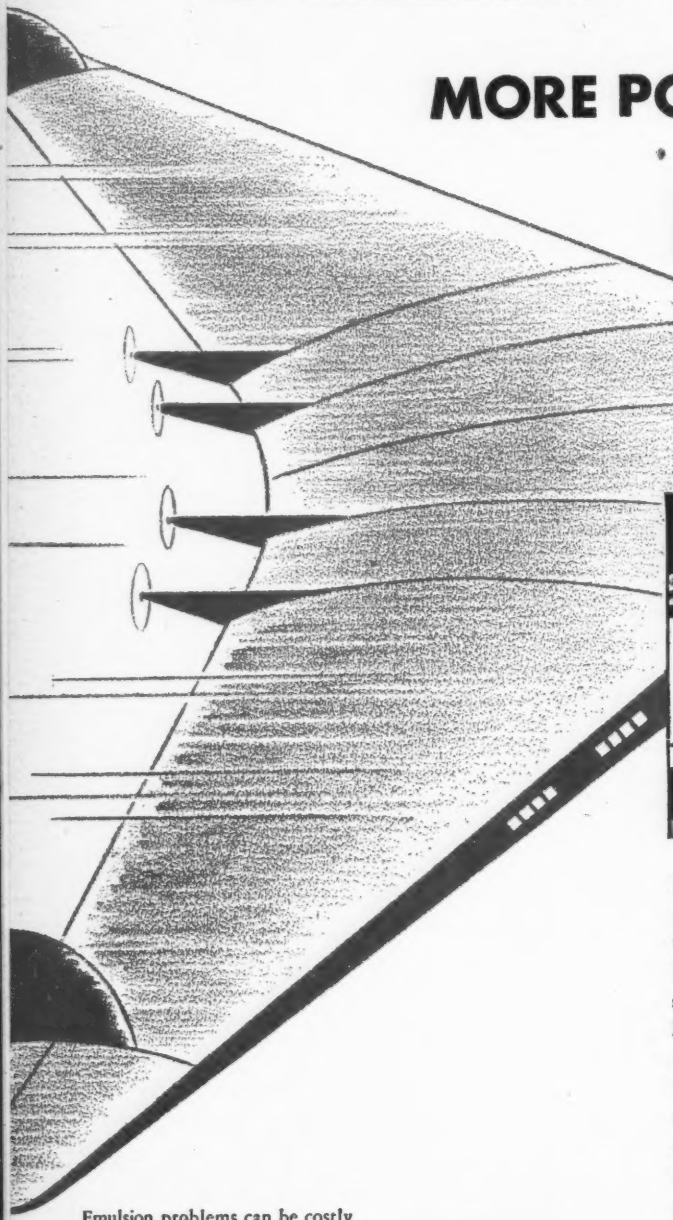

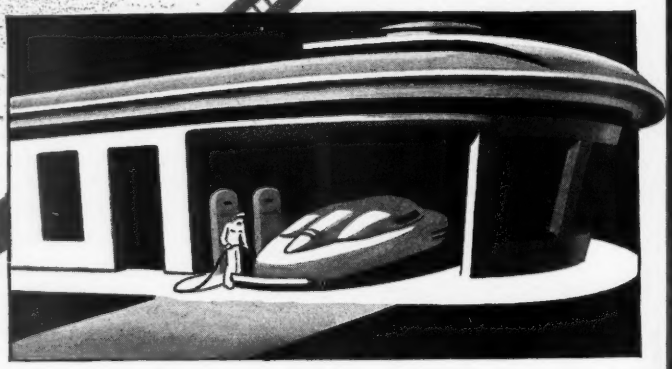

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of the stuffingbox, (gland and cage-ring), the packing itself being split. No other parts of the pump have to be taken off.

c. It gives a good warning of deterioration and ample time for correction before failure.
d. With some difficulty and possibly some damage to the shaft or sleeve, it permits in most cases the completion of the run under adverse conditions.
e. It can be used for high temperatures, and is less sensitive against impurities and solids (crystals, sand, etc.)
f. First cost in most applications particularly in difficult ones is smaller.

The Mechanical Seal

a. The leakage from it is negligible and keeps tight when the pump is standing still.
b. Under proper application the operating cost, that is replacement of the worn parts is smaller.
c. Once installed, it requires no further adjustment.
d. Less senstitive against variable packing pressure.

The statements about the pliable packing applied in negative for the mechanical seal and vice versa, constitute their relative disadvantages. Further developments, particularly with proper pump design for the mechanical seal, are expected to remove some of its disadvantages.

Unquestionably for a number of **duties,** the mechanical seal is the proper one e.g. where the required number of units for any special purpose is great, as automobile cooling water pumps with their specially designed stuffingbox for mechanical seal. It may be applied also successfully under difficult conditions for light hydrocarbons with temperatures below 300° F and packing pressures below 300-400 psi, where the supervision is good and the seal oil supply unfailingly assured and for clean oil up to 600 psi. In the **present status of the art** there are enthusiasts for it, who try to apply it everywhere, while others would not have one in their refinery. As the success of the mechanical seal depends as much on the application and supervision as on the design, most pump manufacturers take a neutral attitude, just as they did with packing material from different sources, even though, when dealing with less experienced users, they are ready to make recommendations based on past experience. While many pump manufacturers are developing special mechanical seals for special applications, they prefer, as a rule, to rely on an outside source of standardized products, as they do with packing material. The manufacturers of packing and seals have experienced service men in all territories and as packing or seals are for them the only products to sell and not a minor part of a machine, they are bound to have wider field experience and give better service than pump manufacturers are able to do. As the selection of either one of the two solutions is arbitrary and depends on the equipment manufacturer or refiner, the pump manufacturer has to be ready to furnish pumps for either one and in some cases make his design such, that with very minor changes of the smaller parts either solution may be applied. While the designs developed for the two purposes are often ingenious, seldom if ever can one design be the best one for two materially different schemes, that is using the same stuffingbox with packing and with mechanical seal.

Fig. 6 Stuffingboxless Pump, complete unit assembled.

Fig. 7 Stuffingboxless Pumping element and motor removed from barrel.

It is up to the engineers in the refineries and pump industries to accelerate the development of the mechanical seal so as to have clear limits of its application and eliminate the headache of having two solutions arbitrarily selected.

This paper would not be complete without mentioning the solution, which our marines successfully apply in the Pacific war against the Japs, namely their total elimination. The best solution for the stuffingbox is the same and in some very special applications the Byron Jackson Co. built **stuffingboxless pumping units** on the principle that the connecting chamber between the driving unit and the pump is no longer in the atmosphere but in a liquid subject to the same pressure as obtains in the pump next to the shaft. (Figs. 6 & 7.) The rational solution calls for a tank filled with the pumped liquid, in which both the driver and the pump is located, the driver in this case being an electric motor filled with liquid so that the whole unit is under the same pressure as the pressure within the pump next to the pump coupling. This is quite simple, if the pumped liquid has a high

(Continued on Page 32)

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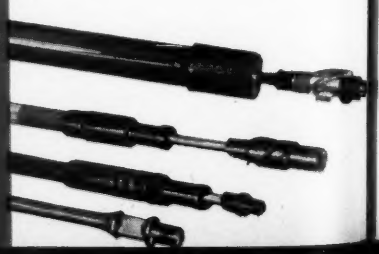

Use of Gel Cement in the Cementing of Casing

The importance of properly cementing casing in an oil or gas well is universally appreciated because it is through the effectiveness of the cement job that the casing is anchored in place, the pipe is protected and fluids are confined to their native strata. To be totally effective the cement should fill completely the annulus between the casing and the formation, it should form a bond between the pipe and the formations, the mass of cement should be homogeneous and uncontaminated by mud, and the cement should extend up around the casing for a desired height without channeling. Various factors will frequently make difficult the fulfilling of one or more of these requirements and the use of gel cement for overcoming adverse conditions often encountered is here discussed.

By gel cement is meant the cement made by the addition of a small amount of Aquagel to any construction, oil-well or special cement, the Aquagel being a carefully selected bentonite which is specially prepared for oil field use. The gelling properties given to the cement by this highly colloidal material impart specific characteristics to the slurry and each of these characteristics has a definite influence on the slurry during its placement and while the cement is setting.

Each oil well cementing problem necessitates a valuation of the required physical properties of the cement slurry and of the cement when it has set. Whether a neat cement or gel cement is used, present oil field practices involve an engineered approach to the cementing operation. No attempt is here made to review cementing procedures but attention is called to several important treatises on modern cementing practice which are listed at the end of this article. Excellent engineering service is provided by cementing companies and cement manufacturers to aid in the selection of cement with specifications to meet particular oil field problems.

The fineness of cement is a factor in determining the setting time; and because thickening rate (which corresponds to some extent to the setting time) is so important in modern cementing operations, the surface area of the cement is now being widely used by manufacturers as a fineness specification more precise than screen tests. Surface area is the sum of areas in square centimeters of the particles contained in one gram of the cement in question. The approximate surface area for each of three types of cement widely used in oil wells is:

Slow setting .....1000 - 1700
Construction .....1700 - 2200
High early strength 2200 - 3000

The actual rate of thickening varies to some extent, with different cements of the same setting time classification and is greatly influenced by water-cement ratio, temperature and pressure. A consistency test made with some form of consistometer is therefore frequently necessary to determine the proper mixture to use.[1] While the addition of bentonite to cement slurries of a given water-cement ratio decreases the period of pumpability, this diminution is counter-balanced, and in many cases more than outweighed, by the increase in the pumpability time resulting from the larger water-cement ratios ordinarily used with gel cement.

Scientific mud control during drilling has contributed to the increased success in cementing. If a well has been drilled with a good mud, caving will have been minimized, the

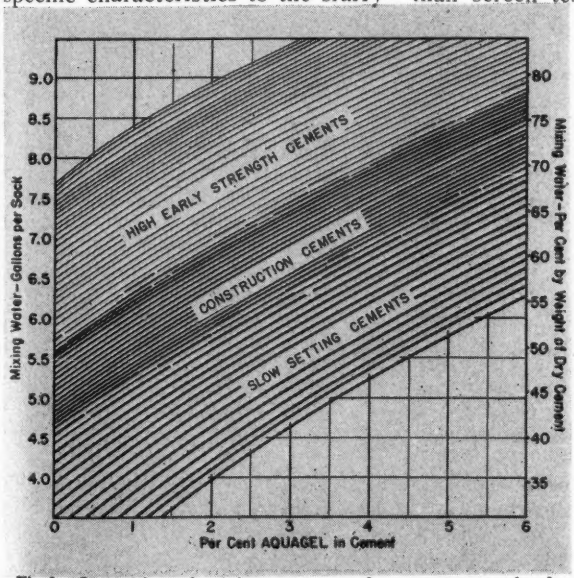
HIGH EARLY STRENGTH CEMENTS
CONSTRUCTION CEMENTS
SLOW SETTING CEMENTS
Mixing Water—Gallons per Sack
Mixing Water—Per Cent by Weight of Dry Cement
Per Cent AQUAGEL in Cement

Fig.1—Quantities of mixing water and percentages of admixture required to produce slurries which will give no free water on setting, for various types of oil well cements, the cement and admixture being pre-mixed dry at plant or in hopper.

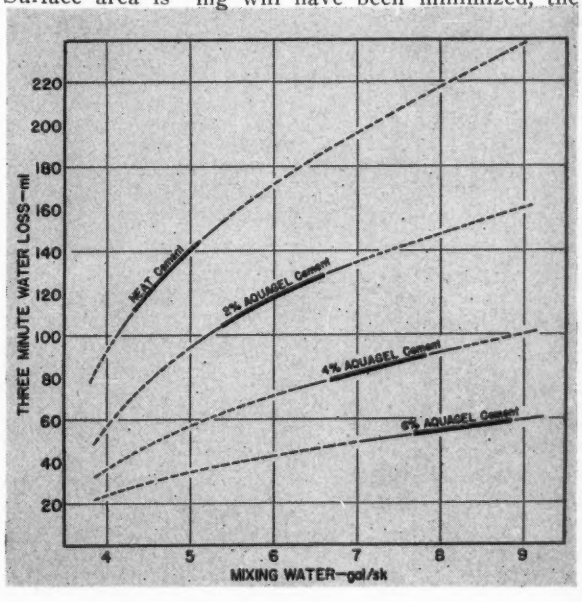

Fig. 2—The water loss characteristics of a typical construction cement with various percentages of admixture and various quantities of water.

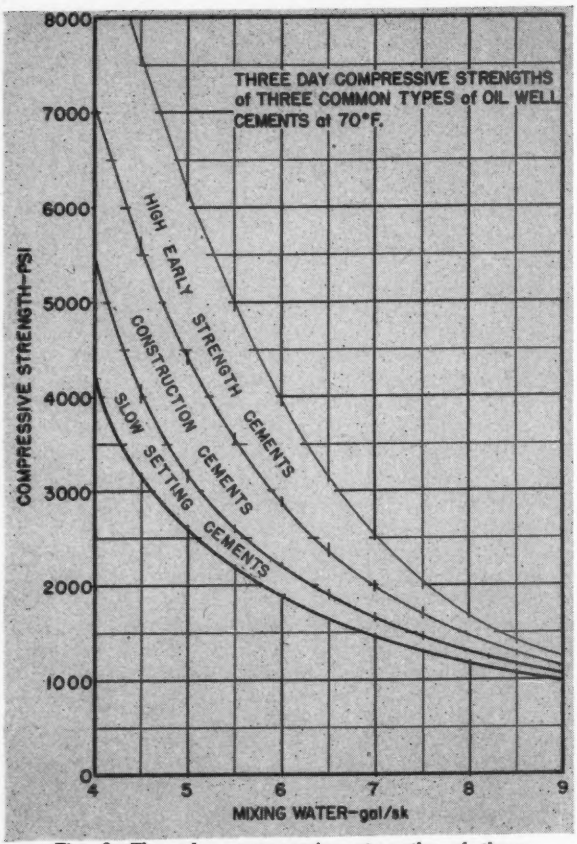

Fig. 3—Three-day compressive strengths of three common types of oil well cements at 70° F.

permeable formations will have thin filter cakes, and a better conditioned hole will have been provided. The best results in cementing with any kind of cement are obtained when the mud with which the hole has been drilled has certain characteristics. The wall-building properties must be right since a low-water-loss mud minimizes the wetting and caving of shales and its thin filter cake reduces tight hole difficulties to the minimum. The initial gel strength should be sufficient to prevent settling of cuttings and cavings and the consequent formation of bridges around the casing collars. The final gel strength should be low enough to permit the mud to be displaced from the hole as completely as possible.

The proper mud, however, is not always used during drilling and mud conditions in the hole are not always what might be desired. Sometimes bad mud conditions are not suspected when they are actually present. Since gel cement moves with a plug flow it can be used to advantage under such conditions. The piston action of the gel cement forces the mud ahead of it without mixing with the mud fluid and the deposited cement is thus not contaminated. The plug flow scours the wall of the hole and fills in irregular surfaces on the formation. Because the gel cement flows in a compact mass the entire annulus is filled with the slurry, tending to eliminate channeling and promoting the primary purpose of completely bonding the casing to the formation with a homogeneous body of cement for the entire distance it extends up behind the pipe.

The weight of the slurry is a definite factor when cementing high behind the casing, when placing cement opposite a low pressure zone and when cementing off theif zones. The weight of gel cement is less than that of a neat cement used for the same purpose, mainly because additional water is used to hydrate the gel material added to the mix. The volume of slurry is also greater per sack of cement.

Of great importance, however, is the fact that no free water is released from a properly proportioned gel cement and the volume of the set cement is approximately the same as the volume of the slurry. In a paper on gel cements[2] it is stated that "For every cement there is a water-cement ratio at which the cement stays in suspension until the initial set has taken place and the set or hardened volume of the slurry is the same as the fluid volume." It is also stated of slurries mixed with more water than this critical ratio (slurries yielding free water) that there is a percentage admixture of bentonite . . ." for every cement and water-cement ratio which will hold the cement in suspension until the initial set has taken place and the set or hardened volume is the same as the fluid volume." The quantities of mixing water and percentages of prepared bentonite that are required to produce slurries which will give no free water on setting with the various types of standard oil well cements are shown grapically in Fig. 1.

The use of gel cement prevents the collection of large quantities of free water on the set cement surface and insures that the cement remains at the height at which the slurry was placed. It is difficult to say just how much free water will appear on the top of any particular neat cement in a given field application, even when the laboratory value is known, because variables encountered in the field (such as temperatures, length of time and degree of agitation, lapse of time between shut-down and initial set, variation in composition by contamination and filtration) have effects on this value.

Water loss into the formation should also be considered. Neat cements made with 4½ gal. of water per sack of cement (40 per cent slurry) have been found to have water losses ranging from 40 to 340 cc. in the first three minutes at 100 p.s.i. in the A.P.I. wall builder tester. In thirty minutes these slurries would lose from 100 to 1000 cc. and deposit correspondingly thick filter cakes. When the water content is increased the water loss becomes much higher. In thin, dilute slurries of gel cement the water loss is reduced to that of a neat slurry containing 4½ gal. of water per sack of cement, or even to a lower figure in some mixes. This property is shown graphically in Fig. 2.

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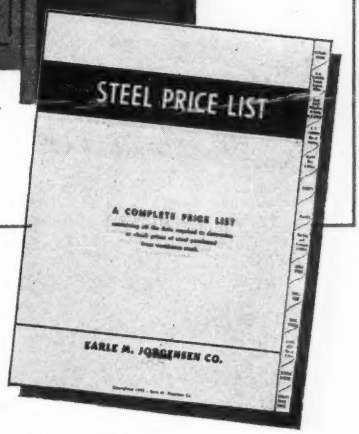

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Table 1
Shear Strength of Set Cement

SLURRY No.	SAMPLE No.	HEIGHT of CEMENT In.	SHEARING FORCE Tons	AREA OF 7-in. CASING COVERED by CEMENT Sq. In.	SHEAR STRENGTH Lb. Per Sq. In.
1 (3% Aquagel; 7 gal. water per sack)	1	81	65	1782	73
	2	82	65	1804	72
	3	81	62	1782	70
			Avg. 64		Avg. 71
2 (Neat cement; 7 gal. water per sack)	1	75	52	1650	63
	2	75	60	1650	73
	3	75	60	1650	73
			Avg. 57		Avg. 69

Table 2
Typical Proportions for Gel Cement

Type of Cementing Operations	Water: Gal/Sack	Per Cent* Aquagel
Cementing surface strings	7½	3
Full-hole cementing, shallow holes	8½	4
Cementing casing, moderately great depths and high temperatures	7½	3
Squeeze cementing, average depths and temperatures	4½ to 5	1

The strength of a cement used in oil wells is mainly that required to anchor the casing safely in place, an essential factor in securing a shut-off. In a paper[3] presented before the A.P.I. the statement was made that "A good oil well cement . . . should show a rapid gain in strength after setting. High ultimate strength is probably not necessary." In general, the strength of the cement lying in the annulus and bonding the casing to the formation need not be greater than the strength of the formation which it covers. The strength of any particular cement when set is affected by the water-cement ratio of the mix and the strength decreases with the amount of mixing water used per sack of cement. This applies to gel cement as well as neat cement. The graphs given in Fig. 3 show the three-day compressive strengths of varying cements mixed at varying water-cement ratios and cured at room temperatures.

There are many cases where a high water-cement ratio is desired. These cases are chiefly higher fill-ups behind casing, the necessity for lower pumping pressures or the desire to minimize channeling. While lower compressive strength accompanies the high water-cement ratios, the strength attained is probably well above that necessary for a satisfactory job. Other characteristics of the high water-cement ratios, however, should be considered. These characteristics which consist mainly of high water loss, release of free water, shrinkage and settling of cement particles, are eliminated in gel cement made with whatever type of cement is specified for the particular job.

Little attention has been given to the testing of shear strength of cements although shear is an important factor in the ability of the cement to anchor the casing in the hole and thus provide an effective shut-off. Some recent tests have been made with both neat and gel cement and these are given in Table 1. In making these tests the slurry was mixed to simulate field conditions as nearly as possible and was then placed between lengths of 10¾-in. and 7-in. casing. After the cement had aged three days the test set-ups were placed in a hydraulic wheel press and the force required to shear the cement (to move the 7-in. casing in relation to the 10¾-in.) was determined.

Based on the shear strength of the gel cement as found by these tests it can be computed that when cement of the kind tested is used for cementing a string of 8⅝-in.-38 lb. casing at 6300 ft. it will require but 10.3 lineal feet of cement to provide sufficient shear strength to hold the casing. Since a string of casing would be cemented for a considerably greater distance up behind the casing, the factor of safety would be nearly 10 for each additional hundred feet.

In addition to the adaptability of gel cement for high fill-up jobs because of its light weight, plug flow with mass movement up the annulus, non-shrinkage and lubricating qualities provided by the highly colloidal admixture in the cement, the characteristics of gel cement have been found to aid materially in cementing casing through troublesome zones.

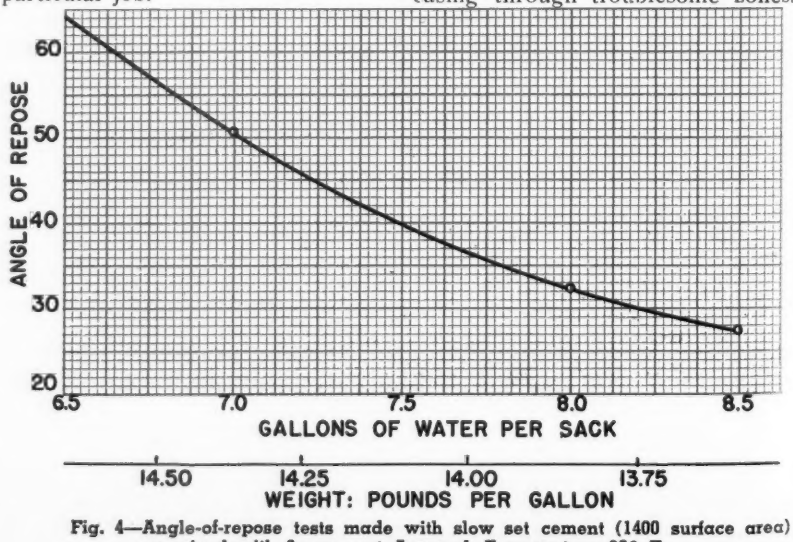

Fig. 4—Angle-of-repose tests made with slow set cement (1400 surface area) pre-mixed with 3 per cent Aquagel. Temperature 80° F.

As an example a well in the Ventura Avenue field had been drilled to approximately 5000 ft. and it was decided to set a string of 9⅝-in. casing through some zones causing trouble because of loss of circulation and gas flows. While drilling, these zones could not be sealed with a mud sheath for any great length of time.

During the running of the casing the mud returned until about 20 minutes before the casing was landed. It had been planned to circulate low viscosity mud for an hour before cementing but, with circulation lost, the mud pumped away without returns after the casing was landed. It had been decided to use a gel cement and because of the lost circulation it was felt desirable to use a mixture giving a high angle of repose at first in order to plug the thief area and allow the cement to rise to the desired height behind the casing.

The angle of repose of a cement slurry is the angle assumed by the slurry when it is poured on a flat surface. The plastic properties of gel cement provide for high angles of repose and the angle of repose can be controlled by the amount of gel material and water used in mixing the slurry. Holes can sometimes be drilled through formations which, when cased off, will take a neat cement slurry as fast as it is pumped in and never allow the cement to extend up through the zone to a height necessary for a satisfactory job. The gel cement will usually seal or bridge off such formations and permit the slurry column to be carried up past them.

In determining the cement to use for this Ventura Avenue well, consistency and angle-of-repose tests as plotted in Figs. 4 and 5 were first made. The high angle-of-repose cement was used for the first five minutes when it was decided that sufficient slurry of this kind had been utilized to plug the lost-circulation zone. The originally planned mixture weighing 102 lb. per cu. ft. and having a lower angle of repose was then started through the pumps. The slurry was displaced with 1770 cu. ft. of mud, allowing some cement to remain in the casing and not bumping the plugs. A temperature survey was made to find the top of the cement which was located at 1975 ft. and was thus well above the troublesome gas and lost-circulation zones which had been sealed off satisfactorily.

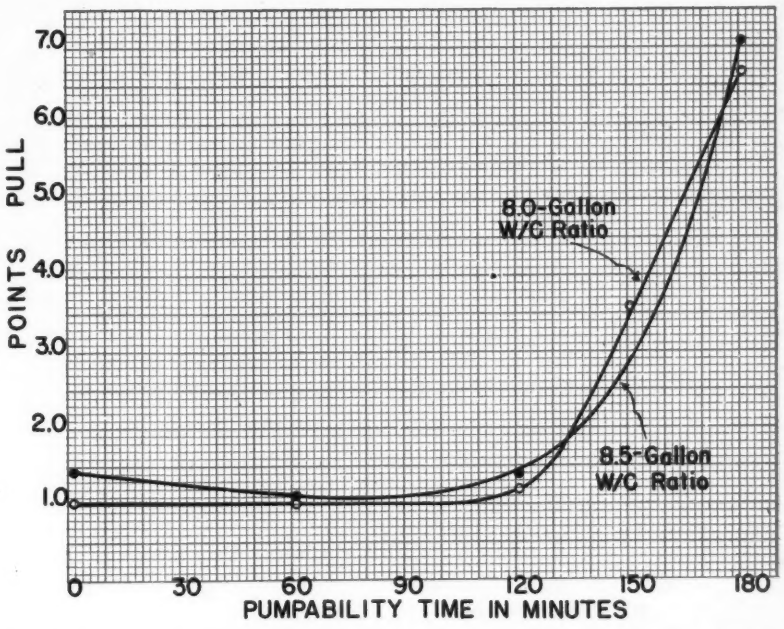

Fig. 5—Consistometer tests made with slow set cement (1400 surface area) pre-mixed with 3 per cent Aquagel. Temperature 145° F.

The angle of repose of gel cement is an important factor in recovering lost circulation, particularly in crevices and cavernous openings. A discussion of this adaptability of gel cement does not, however, come within the scope of this article.

Variations of consistency and setting time caused by the use of different types of cement and widely varying field conditions (such as total depth, bottom-hole pressure, formation permeability, casing-hole clearance, etc.) obviously make it impossible to designate the amount of admixture to use in mixing a gel cement for a particular job. Each new cement job must be individually engineered. In Table 2, however, are shown how gel cement has been used in certain typical instances.

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Salton Sea Activity

A large number of operators, both majors and independents, are showing considerable interest in the area surrounding the Salton Sea, with leases bringing top royalties and bonuses. To date only two operators have started to work. The Pure Oil Co. has the derrick erected on section 26-10s-9e, for Truckhaven Unit No. 1, and the Standard Oil Co. is preparing location for San Felipe No. 1 on section 27-11s-9e. Several other companies are reported to have seismograph parties working in the area.

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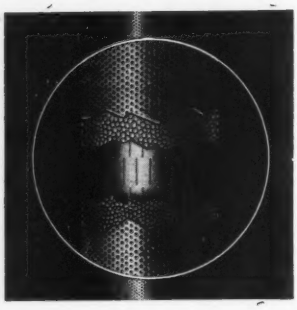

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(Continued from Page 25)

dielectric strength, some lubricating quality and does not contain chemicals harmful to the motor. Where the pumped liquid does not comply with these specifications, the motor is filled with a light oil of high dielectric strength and separated from the pump liquid by a mercury seal without metallic contact.

Looking at the final machine we see a vertical pipe closed at the bottom with a suction nozzle near the upper end and a cover at the top with a discharge nozzle and a cable connection. This is particularly appealing, when it is compared with alternate standard design with as many as twenty valves and a lot of piping and auxiliary devices that have to be watched. As a whole, these units were quite successful, however in some cases they caused more or less trouble, but even in the latter instances the users continue to ask for them as even with troubles they prefer their simplicity and elimination of the operating supervision of the standard units for the particularly hazardous or special conditions, where they are used.

Tidelands Test Spudded

Northwest of the town of Seal Beach, in section 11-5s-12w, the Gilco Inc. State No. 1, is drilling ahead below 1000 ft. after cementing 11¾-inch surface casing at 821 ft. The well is being directionally drilled to the south to test a structure off shore from the mouth of Alamitos Bay. It is estimated that a measured depth of 10,000 ft. will be necessary in order to reach the objective which is thought to be at a vertical depth of approximately 6500 ft.

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Drilling Fluid For the Completion of Shallow Wells

(Continued from Page 15)

low pressure zones vary greatly in sand content, permeability and saturation over short distances. Moreover, in the operator's desire to obtain the best possible completion at the cheapest cost, it is difficult to impress him with the value of any controlled research. For example, if a good completion is obtained with bentonitic gel; or with oil-base; or with crude oil; or with plain mud, then there is no reason in the operator's opinion to change to some other mud for any later well, for which he can not be blamed.

Despite these difficulties of control, there are some field data that offer a comparison of the effect of different fluids on production.

Oil-Base Completions

In the West Coalinga Oil Field, several wells were drilled in one area to the Light Oil Zone and to the Tar Zone with various types of drilling fluids. In two wells, the zone was drilled and the well completed with water-base mud. Four wells were drilled and completed with oil-base fluid. Five wells were drilled with water base mud and completed with one or another type of oil-base fluid. Table I shows the comparison of initial production and settled production in the second month. Due to the varying amounts of sand thickness, production rates were reduced to barrels per foot of sand penetrated. Sand counts were made as carefully as possible to include only that sand considered permeable by determination from core analysis, by sight, or in the case of lost cores, from the self-potential curve of the electric log.

As seen from Table I, the poorest productivity occurs in those wells which were drilled and completed with water-base mud. In the Light Oil Zone, the water-base well had the initial production of 3.2 barrels per foot of sand as against 5 barrels per foot of sand from the best well drilled and completed with oil-base mud. In the Tar Zone, water-base initial production was 1.1 barrels per foot of sand. The best oil-base completion was 2.5 barrels per foot of sand. In comparing wells in the Light Oil Zone, there seems to be little advantage in drilling through the pay zone with oil-base mud over drilling through with water-base mud, but considerable advantage in completing with oil-base mud.

While it is felt that to draw conclusions on results involving a comparison of but two wells out of a group of eleven would be presumptious, nevertheless, the advantage of oil-base mud is indicated.

Crude Oil Completions

Many wells have been successfully completed by using crude oil as circulating fluid and evidently its use is advantageous compared with the use of water-base mud. This seems to be particularly true when using perforation sizes other than very fine. When using fine mesh liners, however, some field experience indicates that it is difficult or impossible to remove by thorough washing the oil-mud-water emulsion formed when drilling or wall-scraping. This mixture may be so impervious as to actually shut off formation water. In a well of doubtful oil content drilled at Lost Hills, a 40 mesh liner was set after wall-scraping and washing with oil. When the well was bailed dry, the liner was washed with distillate and the well completed for 15 B/D of salt water. The liner was then gun-perforated with half-inch holes and the well again recompleted for 130 B/D of water.

In other areas, however, it is reported the use of crude oil has shown considerable increase in the initial and settled production over wells completed with water-base fluids.

One of the reasons that crude oil can be successfully used in certain fields is because of the low bottom hole temperature. The relationship between this temperature and the solubility of shale in crude oil is not fully understood but from the effect of crude oil at high temperatures on shale it is suspected that straight crude oil can not be used in areas where bottom hole temperatures are high.

Special Drilling Fluid Completions

Comparative data are unavailable by which conclusions can be drawn on the effect of using bentonitic gel muds or chemically treated muds for

TABLE I

PRODUCTION COMPARISON — WATER BASE vs. OIL-BASE DRILLING FLUID

		WEST SIDE COALINGA — LIGHT OIL ZONE							TYPE FLUID	
Well	Perf.	Sand Count Feet	Gross I.P. Bbls.	Bbl. Ft. Sand	Ave. B/D 2d Mo. Gross	Bbl. Ft. Sand	Ave. B/D 2d Mo. Net	Bbl. Ft. Sand	Drill In	Completion
1	25 ga.	10	32	3.2	30	3.0	27.5	2.7	W.B.	W.B.
2	30 ga.	14	70	5.0	55	3.9	49	3.5	O.B.	O.B.
3	30 ga.	29	128	4.4	106	3.7	104	3.6	O.B.	O.B.
4	30 ga.	17	83	4.9	65	3.8	50	3.0	O.B.	O.B.
5	40 ga.	15	51	3.4	46	3.1	40	2.7	O.B.	O.B.
6	40 ga.	14	55	3.9	48	3.4	20	1.4	W.B.	O.B.
7	G.P.–¼″	28	132	4.7	124	4.4	104	3.6	W.B.	O.B.
					TAR ZONE					
8	G.P.–¼″	26	65	2.5	65	2.5	54	2.1	W.B.	O.B.
9	G.P.–⅛″	22	30	1.3	30	1.3	25	1.1	W.B.	O.B.
10	G.P.–¼″	27	44	1.6	44	1.6	30	1.1	W.B.	O.B.
11	G.P.–¼″	25	27	1.1	24	0.9	18	0.7	W.B.	W.B.

W.B.—Water-base mud.
O.B.—Oil-base mud.

TABLE II

COST OF SPECIAL FLUIDS—$/BBL.

	Initial	Recovery	Net	Trucking and Facil.	Mixing and Wash.	Total	Savings on Bailing	Net	Remarks
Type A Oil Base	$7.00	$4.60	$2.40	$0.59*	$1.00	$3.99	$0.92*	$3.07	Wash with oil to recover.
Type B Oil Base	5.00	3.25	1.75	0.59	1.00	3.34	0.92	2.42	Wash with oil to recover.
Bentonitic Gel	0.35	....	0.35	....	0.62	0.97	....	0.97	
Special Chem. Treated Fluid	0.70	....	0.70	....	0.25	0.95	....	0.95	
Hole Mud									
Additions and treatment of cement cutting—								0.50	

*—Based on volumes for 2200 ft.—6⅝″ hole.

completion over the use of ordinary water-base mud.

For the chemically treated mud, the best that can be said is that it apparently has no detrimental effect as compared with wells completed with normal water-base fluid. One well drilled in South Belridge was located in the middle of a group of wells completed in the normal manner with the usual water-base mud. This well was drilled to the top of the zone with water-base mud, the casing set and the zone drilled with an excessively alkaline fluid treated with hydrolized starch. Initial and subsequent production is comparable to the average of the wells drilled with water-base fluid.

Costs of Use of Drilling Fluids

Table II shows a comparison of the cost of using two types of oil-base drilling fluid, bentonitic gel fluids, chemically treated fluids, and ordinary water-base mud. These are calculated on a per barrel basis and on volumes necessary for 2200 feet of 6⅝" hole. They include trucking and other facilities wherever necessary, mixing time, and wash oil necessary to recover oil-base drilling fluid. Cost of oil-base mud is not calculated on initial cost but is based on recovery of, at least, 65% of the total volume used. Very frequently 80% to 90% is recoverable, but occasionally 50% is lost. Therefore, the 65% figure is used as a conservative average.

Conclusions

It is an obvious fact that, of the many shallow wells drilled in California in low pressure zones, most must be regarded as successful completions, though drilled without particular attention to the type of drilling fluid used.

Whether or not the completions would have been larger if drilled with fluids other than standard water-base mud is difficult to determine, but there is considerable unassociated evidence that this is the case.

From the data presented, it may be concluded that:

1. There is definite proof of seepage of water from the ordinary drilling mud into the sand bodies encountered in the hole.

2. The seepage of fresh water into the producing sands should be kept at a minimum or eliminated entirely to insure maximum productivity. There is definite evidence that the use of oil-base drilling fluid provides greater initial and settled production.

3. The use of oil in areas where shales are present, that are apt to slough on contact with oil, should be avoided as it may be harmful for the maintenance of sustained production. Sloughing, started by drilling oil, may be continuously aggravated by formation oil.

4. The favorable results of fluids other than water-base muds are indicated by many examples of good well completions, but the final evaluation must be deferred for further study.

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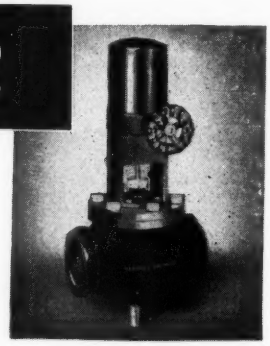

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Should Oil Development on the Public Domain Be Encouraged?

Abstract

It is generally assumed that oil development on the public domain should be encouraged, particularly at the present time. It is, however, being impeded and discouraged by the Secretary of the Interior even though as Petroleum Administrator for War he is doing everything within his power to encourage prospecting and exploratory work. It seems positively absurd for the Secretary to take this position as Petroleum Administrator for War, and, at the same time, as Secretary of the Interior, to positively discourage the exact thing he is attempting to encourage. Is it a coincidence that he has recently proposed oppressive regulations governing operations on the public domain and that they were proposed at the same time that the Petroleum Reserves Corporation was formed to put the Government into the oil business?

It is the policy of certain members of the Administration to conserve in the ground the undiscovered oil and gas resources of the public domain, even though this policy results in damage to privately owned oil and gas fields, because the Government is worried about our oil supply for the next war. The policy may also be to so handicap private industry in its operations on the public domain that some support can be obtained for Government development and operation on the public lands.

* * *

By R. M. Allan, Jr.

The Superior Oil Company

R. M. Allan, Jr.

Early last fall I attended a meeting of the Conservation Committee of California Oil Producers, at which time the proposed new Federal Unit Plan Regulations were discussed and it appeared that the Committee was greatly disturbed by the type of regulations that had been proposed. As a result the Chairman, Mr. Clark, was authorized to appoint a committee to study the proposed regulations and report back to the General Committee with recommendations. Mr. Clark thereupon appointed as members of this Committee:

L. A. Cranson, Honolulu Oil Corp.; Olin Lane, Continental Oil Co.; Ross McCollum, National Oil Co.; B. E. Parsons, General Petroleum Corp.; R. C. Patterson, Belridge Oil Co.; C. P. Watson, Seaboard Oil Co. of Delaware, and myself.

By some strange quirk of fate I ended up as Chairman and have been alternately fumbling and carrying the ball ever since.

I cannot praise too highly the cooperation given me by the other members of this committee, without whose suggestions and recommendations, our work could not have been carried on. I am getting ahead of myself, however, and I had better go back and explain the cause of all the disturbance.

Under date of April 10, 1943, Oscar L. Chapman, Assistant Secretary of the Interior, caused to be published in the Federal Register a notice of Proposed Regulations governing Federal Oil and Gas Unit Plans, which notice set forth the proposed regulations and the proposed form of unit plan. The notice invited oil and gas lessees, operators, and members of the petroleum industry generally, to file within 60 days with the Director of the Geological Survey in Washington their written comments, criticisms and suggestions with respect to the Proposed Regulations and Unit Plan. The notice further stated that if the response warranted, the Director of the Geological Survey might designate an officer or officers to conduct a hearing on the Proposed Regulations at which interested parties would be given an opportunity to be heard orally.

Denver Meeting

After the notice appeared in the Federal Register nearly every major oil company, and many independents and oil associations filed with the Director lengthy objections and criticisms of the Proposed Plan, and as a result the Secretary called a meeting which was held in Denver, Colorado, on November 17th, 18th and 19th of last year to which the Conservation Committee sent Judge Wm. L. Holloway of San Francisco and myself.

As many of you know, the Secretary of the Interior has for years been issuing regulations governing oil operations on the public lands without any advance notice to the industry or the public generally. These regulations have always been issued in an arbitrary and dictatorial manner without notice or an opportunity to be heard of any sort. Then all of a sudden, the industry is invited to attend a meeting and air its views on proposed new regulations.

Frankly, some of us thought it was too much of a coincidence that the Secretary should have a change of heart at the same time the Kettleman royalty suit was at issue. You may recall that this is an action by the Secretary to require the parties owning production at Kettleman Hills to pay the Government royalty

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on the basis of an arbitrary value fixed by the Secretary, which value was, of course, somewhat more than the market price. The merits of that case are not material here, but what is important is that one of the most potent arguments the defendants had was that the Secretary had not exercised due process. In other words, the Secretary, arbitrarily, without notice or hearing of any sort, prescribed an increased royalty for the Kettleman operators.

At the Denver Meeting, Judge Holloway and I pointed out that we had noticed the coincidence, and we took the position that if by holding the meeting and giving the operators a chance to be heard, the Secretary hoped in some manner to obtain the Operator's consent to the new regulations and to avoid any due process objections, that we, on behalf of the California Operators we represented, refused to consent to any such regulations. In all fairness I must state that I was assured privately by an attorney for the General Land Office that although the Kettleman suit was under consideration by the same parties at the same time, that the issues in that case had no bearing on the decision to give the operators a chance to be heard before being subjected to a multitude of new regulations.

Proposed Regulations Scored

The regulations proposed in April of 1943 were just about as bad as any regulations could possibly be. Anyone that has studied the Acts of Congress, which are the basis of the Secretary's power, in connection with the formation of unit areas, cannot help but agree that the Congressional intention is clear. Congress intended that unit agreements be prepared by the parties who were interested in unitizing an area, that the agreements be so drawn as to fit the conditions in each area, and that each agreement should actually be an agreement in fact as well as in name, which of course, requires that it be entered into on a voluntary basis without coercion or compulsion of any sort. A unit agreement is not at all where, instead of being entered into on a voluntary basis, its terms are dictated by the Secretary, an dthe parties have no choice but to comply, yet, this is exactly what the regulations proposed.

The Act of Congress provides that regulations shall not conflict with State laws, but a section of the proposed Regulations reads "State laws must be observed by the unit operator, insofar as such laws are not in conflict with Federal law or regulation". This provision attempts to provide that regulations issued by Secretary Ickes will supersede State laws. State governments have never been anxious to join unit agreements and you can guess what chance there will be to include State lands in unit agreements with this type of regulation. You can imagine the plight of a poor operator required to abide by regulations when he can be required to violate the laws of the State in which he is operating.

Since 1935 all leases issued by the Secretary contain a requirement that the lessee must join any unit plan approved by the Secretary. If we add to this power the right to dictate the terms of the plan, the poor lessee or operator had better find a new business.

I could go on indefinitely discussing the bad features of the regulations proposed in April of 1943. Needless to say, the Director of the Geological Survey was swamped with criticisms and objections from nearly every company or individual having an interest in the public lands. As a result of this avalanche the regulations were revised shortly before the Denver meeting, and some of the least objectionable features were eliminated.

More than one hundred representatives of oil companies, associations, public land states, drilling contractors and independent producers attended the meeting held in Denver on November 17th, 18th and 19th. The roster of the meeting reads like a who's who of oil company lawyers and executives from every oil producing State west of the Mississippi. The Geological Survey and the General Land Office were, of course, well represented as was the Petroleum Administration for War. Wirt Franklin attended as an observer for the Petroleum Administrator for War and voiced a plea that no further impediment, or inhibition of any kind be put in the way of exploration work on the public domain. We were also fortunate in having at the meeting with us Senator O'Mahoney from Wyoming, Senator Murdock from Utah, Senator McCarren from Nevada, Senator Millikan from Colorado, Representative Chenoweth from Colorado and Mayor Stapleton of Denver. Assistant Secretary of the Interior, Oscar Chapman, presided at the meeting and as is customary, called on the Senators for a few remarks.

Senator Defends Bureaucrats

Senator Murdock made a rather stirring plea for tolerance in dealing with what he termed the "bureaucrats" and he did a very nice job of defending the so-called "bureaucrats" as necessary evils. This started the meeting off on a very high plane, from the Government's viewpoint at least. Then Senator Pat McCarran, who must have known something of the type of regulations we were fighting, was called on for a few remarks and since they received such a tremendous ovation from the industry representatives at the meeting I believe they are worth passing on to you as the views of at least one member of the United States Senate, who, unfortunately, is not from an oil producing state.

Senator McCarran prefaced his remarks by saying, "I think when a man has nothing to say, he had better say nothing, and really, I have but little to say excepting you are here to deal with a serious proposition, a serious problem in a serious way". Then he continued, and I quote, "I don't see eye to eye with some of my colleagues; I don't see eye to eye with some of our departments. Perhaps that is the Irish in me, I don't know. It is rather predominant. I believe in government by the people, and I believe that our people are capable of governing themselves.

"I think that the laws that we have had in the past have been conducive to the development of the resources of our country. I think the prospector of the past has been the fellow who has developed the resources of the country, because he had largely a free hand by which, and with which, he could prospect. He could either give his individual efforts or his individual means to the prospecting and developing, or

he could try to induce the means and wealth from other sources, but in the long run, it was the individual who brought out the resources of the country.

"That is true of our mining laws; it is true of our oil laws; it is true of many other laws that we have had, but now, we are quietly, and stealthily, if you please, if I may use the word advisedly, placing the heavy hand of the government over the hand of the prospector.

"The wildcatter is no longer welcome and as the wildcatter goes out of existence, it is rather strange, but the development of the oil field seems to recede. We had oil fields developed as long as the wildcatter had the red tape off of him.

"I believe today that we can produce all the oil that this country needs, and that the world will require during this war, if we will permit the wildcatter, so to speak, to go out and develop and find and produce.

"Then again, there are wells in this country that today cannot produce because they are of the pumping types; the so-called stripper well, which could produce great quantities of oil if there was a little more inducement in the way of the price of crude oil. We can put those wells to work and produce oil but, gentlemen, under the present existing condition, I don't know the reason in particular, but under the present existing conditions, the advice given to our chairman here and the advice given to the Senate and the Congress, is, that the oil reserves of the West are dropping, dropping, dropping continuously to a dangerous point.

"Something should be done. My judgment is, give the people of America a free hand; give the people of the West a free hand."

This was just the type of encouragement we needed because after Senator Murdock's remarks we didn't know whether we should throw all the brickbats we had brought along or not.

Senator O'Mahoney Speaks

Secretary Chapman then called on Senator O'Mahoney for a few remarks and among other things the Senator said, "That the country needs oil for both its war activities and its civilian activities goes without saying. Everybody knows now that we are using more oil than we are discovering, but every oil operator in the West also knows that we have not taken fullest advantage of our opportunities in the public land states to promote the search for new sources of petroleum."

(The reasons why we have not taken full advantage of our opportunities in the public land states are quite clear, as I shall explain later.) Quoting Senator O'Mahoney again, "Everybody agrees I am sure, that the policy both of the Government and of the operator should be to avoid waste of our dimishing oil supply, but everybody should also agree that the Government should take every precaution to avoid impeding the activities of the explorer. If ever there was a time when we should concentrate upon the fullest utilization of the mineral resources of the public lands, it is now."

Later on Senator O'Mahoney said, "It is, therefore, essential that we should concentrate upon stimulating the exploration of the public lands to the very utmost. This is no time for obstruction or delay. It is no time for rigid regulations which curb the initiative of the pioneer. It is the time for liberal construction of the law in a manner that will encourage independent private enterprise in this industry, which is, in truth, one of the most important cogs in the modern economic machine.

"I am convinced that the possibilities of the Rocky Mountain States have not been fully explored. Montana, Wyoming, Colorado and New Mexico should be thoroughly explored and developed. The independent wildcatter will do the job if Washington will let him.

"The Government gets its biggest income when the largest number of people are employed at steady jobs and good wages. The object of the Department of the Interior, therefore, should be to encourage as many people as possible to create jobs upon the Public Domain by the development of that Domain.

"It was this theory which prompted me almost three years ago to urge a flat 12½ per cent royalty as a reward for explorers who discover new deposits of oil or gas on the Public Domain. It took a long time to secure the enactment of that law, but when it was signed on December 24, 1942, I think I may say with propriety, it became the most effective stimulant we have had in many years for the independent search for oil in these Western States.

"More can be done. I believe that the Interior Department should profit by the experience under the Act and exercise the power which the Secretary now has, by the terms of the Leasing Act itself to adopt a more liberal royalty policy. That law was not a limitation, it was in fact a summons to the Department to come to the assistance of the independent operator.

"The fact that Secretary Ickes has not as yet been successful in obtaining a price incentive, should persuade him to seek other incentives. He does not control price ceilings, but he does control oil and gas regulations."

Here again we had much needed encouragement in our fight against unnecessary and unwise regulations. Both of these gentlemen assumed, without question, that exploration and development on the public domain should be encouraged, and, of course, even the title of the Act under which the Secretary gets all his powers over the public domain in regard to oil and gas is "An Act to **promote** the mining of coal, phosphate, oil, oil shale, gas and sodium on the public domain". At the time of this meeting the country had been at war almost two years and the oil industry was straining every muscle to discover and develop badly needed new reserves, and yet there was nothing in Secretary Chapman's opening remarks and certainly nothing in the proposed regulations that led us to believe that the Department was going to make it any easier to operate on the public lands. Is it not natural that we were apprehensive as to the Department's intentions?

As most of you know a very large part of the production and certainly most of the potential oil land in the Rocky Mountain or public land states, is included within the public domain. I am, of course, referring to the States of Montana, Wyoming, Colorado and New Mexico. I am probably stretching a point in calling New Mexico a Rocky

Mountain State, but when the Rocky Mountain Area had four gallon gas coupons and the Southwestern Area had only three gallon coupons, New Mexico would have been very happy to have been designated a Rocky Mountain State.

Many eminent petroleum geologists agree that this great area of some 300,000 square miles, probably contains the greatest potential oil reserves in the country. Included in this area are some 60,000 square miles of public land. On this basis eight per cent of all the oil territory of the United States is in Wyoming, and thirty-five per cent of all the possible oil territory in the country is in Wyoming, Montana, New Mexico and Colorado, the so-called public land states.

Operators in this great area cannot carry on exploratory and development work like we can in California, Texas, Louisiana, Illinois, Oklahoma, Indiana, etc. They are subject to an Act of Congress, the purpose of which was to promote mining, and various regulations, the purposes of which are not quite so clear. Under the Act and these regulations there were drilled on Government land between January 1, 1936 and July 1, 1943, a period of seven and one-half years, 4 wildcat wells in Colorado and 26 wildcat wells in Wyoming. During this same period that 26 wildcat wells were drilled in Wyoming, 21,000 wildcat wells were drilled in the United States. Wyoming produces about two per cent of the Nations' oil and on this basis its share of wildcat wells would be 420 as against 26. On the basis of potential oil area, Wyoming should have had 1660 wildcat wells instead of 26 .

The explanation for this retarded development is, of course, well known to anyone who has had any experience in operating on the public lands. The high royalty, the acreage limitations and the oppressive regulations under which an individual or company must operate are the obvious reasons. We, of course, knew all of this when we arrived in Denver to fight against the imposition of further regulations. The question uppermost in all our minds was **WHY?** Why should the Government at this critical period in our Nation's history attempt to saddle the industry with a new set of regulations which before the time of the hearing the Government knew had the almost unaminous opposition of the entire industry? Did the Government believe that these new regulations would aid the industry in fulfilling its part in the National War effort? We thought these were perfectly proper questions and that the industry was entitled to an answer.

The Conservation Branch of the United States Geological Survey is charged with the responsibility of looking after the Government's interest in Federal oil and gas lands. We all know that beginning ten years or more ago our chief problem was over production and consequently the policy of the Conservation Branch was to conserve our natural resources by discouraging development and production. Senator O'Mahoney and others referred to this fact in their remarks. On the second day of the hearing, Senator O'Mahoney saw that we were shooting in the dark, since we had not obtained any expression from the government officials present as to just what they were trying to do. He thereupon called upon the government officials present to give us a statement explaining just what they were trying to do.

Shortly before Senator O'Mahoney's request, Mr. Dean Terrill, representing an industry group, read into the record a series of seven questions which we considered to be particularly pertinent. A group of us, representing the oil producing areas of Oklahoma, Texas, New Mexico, California, and the Rocky Mountain States, sat up half the night framing them, and we felt that if we could get straight answers our problems might be solved. One of these questions was, **"In** view of the pressing urge for exploration and development of new reserves, is it thought that these, or any, regulations will encourage development on the public domain and promote the war effort?"

No attempt was made to answer this question. Hale Soyster, Chief of the Conservation Branch of the United States Geological Survey, in reply to Senator O'Mahoney's question replied that the Geological Survey has not proposed any change in policy or procedure from the policy or procedure which had been followed since 1930. He stated that they are not proposing anything new. This was hardly a satisfactory answer.

Mr. Soyster's other remarks gave us some encouragement but we, of course, all knew that if we took the most optimistic view of his remarks it wouldn't mean a thing unless the General Land Office and the Secretary's office concurred. My colleague, Judge Holloway thereupon asked the very pertinent question of whether the General Land Office concurred in Mr. Soyster's statement and Secretary Chapman declined to let the Land Office representatives answer. Thus we obtained only Mr. Soyster's general statement and no information as to the policy of the Department of the Interior in the administration of the public oil and gas lands was forthcoming.

It might be well to point out at this time that with one or two minor exceptions, of which I was not one, every industry representative who spoke at the meeting heartily endorsed the principle of voluntary unitization of oil and gas fields as a proper conservation practice, but just as heartily condemned compulsory unitization. Everyone is rapidly becoming unitization conscious in connection with the pressure maintenance and secondary recovery programs that are now becoming so important. I am certain, and I believe the industry as a whole will agree, that nothing will deter development or retard pressure maintenance and secondary recovery programs as much as an attempt by a governmental agency, and not even a war agency, to prescribe the form of unit plan to be used in such cases and then attempt to force the operators to join.

Is it any wonder that operators prefer state or private lands, leaving out entirely any question of the deterring effect of thirty-two per cent royalty, which isn't even on the market price, but is on a value which can be arbitrarily fixed by the Secretary? For years the industry and its associations have been trying to get this royality rate reduced without any success. Finally Senator O'Mahoney forced a re-

duction on the Department by Congressional Action, but this is, of course, only a temporary wartime measure. The Secretary has always had the power to grant leases on an eighth royalty, but has consistently refused to do so, and will you believe it, the Department cited the Senator's Act as a limitation on their power to reduce royalty in situations where the Act was not applicable.

The greatest difficulty that operators have, and which should be borne constantly in mind by the Government, is that owners of fee land will not surrender to the Secretary any more control over their land than may be absolutely necessary. They are willing to put control in the hands of the operators, whose judgment they trust, because the operators are risking their own money and such rewards as may be obtained are shared with the landowners. There is no common interest, however, between the landowners and the Secretary, and if the principle of unitization of Government land in which fee lands are involved is to make any progress, the Secretary must leave the control of operations on fee lands in the hands of the operators and protect the Government through his control over Federal lands.

No useful purpose would be served by further commenting on the proposed regulations. It is enough to say that no matter what further improvements may be made in the proposed regulations nothing can be said that will further the unitization of state and fee lands with Federal lands as much as omitting the regulations entirely.

I wish I were able to tell you the results of our Denver meeting but I don't know. Our only advice was, the suggestions and recommendations of the industry would be studied in Washington and that we should hear something at a later date. I do know that the Geological Survey has done no work on the regulations since the meeting, and, of course, the fervent hope of the industry is that we raised such a storm of protest that we won't hear any more about it.

Why These Regulations

The record of the Survey and the Secretary in the administration of public lands has not been one to encourage exploration for oil and gas. As a matter of fact, the Secretary has consistently taken the position that no inducement is necessary or advisable to promote prospecting and development on the public lands. Now, however, in his capacity as Petroleum Administrator for War, the Secretary is doing everything within his power to encourage prospecting and exploratory work to increase our reserves of oil and gas. It seems positively absurd for the Secretary to take this position as Petroleum Administrator for War, and, at the same time, as Secretary of the Interior, to positively discourage the exact thing he is attempting to encourage.

All this brings up the question again of WHY?

Why should oppressive regulations covering operations on the public lands be proposed at this critical time?

Is it just a coincidence that this comes at the same time that Petroleum Reserves Corporation was formed to put the Government into the oil business?

Is there any explanation for the fact that while the industry members, at least, of the Petroleum Administration for War are doing their utmost to encourage exploration and development that other agencies within the Department of the Interior are actively discouraging exploration and development on a very large part of our potential oil lands?

The explanation I believe is obvious. The newspapers and oil industry publications for the last two months have been giving us the answers. It is the policy of certain influential members of the Administration to conserve in the ground the discovered and undiscovered oil and gas resources of the public domain even though this policy results in damage to privately owned oil and gas fields through production above their maximum efficient rate to supply the United Nations' war needs. This situation is known to many officials of the Petroleum Administration for War, and there is, of course, no question but that this policy is handicapping the industry in its effort to supply the oil necessary to fuel this war.

If we are to believe what we read in the press, the reasons for this policy are probably twofold.

First: The Government is worried about our oil supply for the next war and in addition to our existing naval petroleum reserves, which, as you know, are in the process of being enlarged, the plan is to add to these reserves the oil and gas resources of the public domain.

Secondly: The policy may be to so handicap private industry in its operations on the public domain that some support can be obtained for Government development and operation on the public lands which could, of course, be so managed as to conserve such reserves as might be found, in the ground, as fuel for the next war. It has been reported time and time again that plans are nearing completion in the Department of the Interior for Government drilling and producing operations on the public lands. It is also reported that the Truman Committee is expected to intervene if any attempt is made to carry out such plans.

Ickes' Article Quoted

The Petroleum Industry War Council has taken a determined stand against the Government's entry into the oil business at home or abroad, and the Secretary of the Interior has, on several occasions, denied having any intention of putting the Government into the oil business in this country. The rumors, however, persist.

We have good evidence right here in California of the Government policy of conserving Government oil in the ground for the next war. Our great Elk Hills Naval reserve which could go a long way to take the pressure off other fields in this State is still standing idle while we are called upon to meet a State quota which requires production from our private fields at rates that may be expected to result in an ultimate loss of recovery.

The Secretary of the Interior in an article in the January issue of the American Magazine said, and I quote, "One of our very first undertakings ought to be to store in this country vast quantities of crude and even, if necessary, of refined products. We should store underground where possible and above ground where necessary. This is

not only a practical measure, it will be an urgent thing to do as soon as peace comes. We shall be carelessly exposing ourselves to grave risks unless we build up and maintain reserves that will last at least 20 years, regardless of what the demands may be. We can all remember the day when we had known estimated reserves for 20 years, and we have anxiously learned how rapidly a supply of even that amount can be diminished.

"No nation can ever surely depend upon another succor in time of war. I desire a lasting peace no less ardently than anyone now living, but in the history of the past 25 years is written a warning that a nation as temptingly rich as our own should bind up her strength and be ready for whatever might happen.

"Oil stored here would in no event be wasted, war or no war. Oil stored here could be our very lifeblood. We should buy and buy and buy, and store and store, until we are able to face the whole world, if necessary, with calm assurance. We should start with the certainty that the Allied armies 25 years ago 'floated to victory on a sea of oil'. The oil expended then was nothing compared to what we are using in this war; and what we are using now will be, comparatively, merely a trickle if we should ever be called upon to engage in another world war, as we shall be called upon to do if the world should have another seizure of homicidal mania."

Have we embarked upon a policy of storing underground the undiscovered oil and gas resources of the public domain, or is a foundation being laid for Government operation on the public lands? Frankly, I don't know.

The purpose of the Act of Congress now in effect is to encourage exploration for oil and gas on the public domain. If the oil and gas reserves of our public lands are to be held for the future, this determination should be made by Congress and by the Congress alone.

If the plan is to put the Government into the oil business by way of drilling and producing operations on the public domain, we should fight this attempt with every weapon at our command. The Secretary and other high administration officials are being roundly condemned on every side in connection with our "so-called" foreign oil policy and the activities of the Petroleum Reserves Corporation. Let us not be mislead into wasting all our energies in fighting the administration on foreign oil matters lest we wake up some morning and find the Government in competition with us in this country with some of our best potential oil lands as assets. Let us keep our eyes open and our powder dry.

Presented at Spring Meeting of the Pacific Coast District of the American Petroleum Institute Los Angeles, California March 23, 1944.

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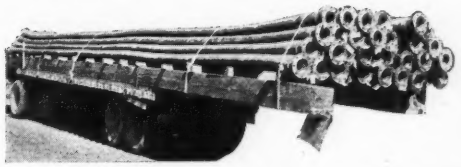

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PIPE WIPERS

THIS LAUGH OFF!!

Sir Thomas Lipton, while visiting Scotland, met an old friend whom he had not seen since they were at school together.

"And how's George?" asked Sir Thomas, referring to an old friend known to both of them.

"Oh," was the reply, "he's dead long, long ago, and I shall never cease to mourn him."

Sir Thomas was deeply touched, and said consolingly, "I never knew you had so much respect for him as all that."

"Na, na, you're wrang there," was the disconsolate reply. "It weren't the respect I had for him, na that; but, you see, I married his widow."

Two WAVES were enroute to California. As their train slowed down, their car stopped opposite an Orange Packing Plant. "Did you ever!" said the first WAVE. "Look at that big sign—'SUNKISSED NAVELS' . . . must be Hollywood."

A housewife opens her refrigerator and finds a little rabbit sitting inside. "Aha," says she, as she spies the bunny. "What in the world are you doing in my refrigerator?" The rabbit peers out and then cranes its neck to catch a glimpse of the nameplate on the icebox. "This is a Westinghouse, isn't it?" he asks of the housewife. "Yes, it is," she replies, "but what are you doing in it?" she inquires further. "I'm just westing," the bunny replies.

Two drillers sat down to eat their lunch. One began to unwrap a package some 18 inches long. "What's that?" asked the other.

"My wife's away," said the first, "so I made myself a pie."

A bit long, ain't it?" his friend asked.

"Long? Sure it's long. It's rhubarb."

"I'm sorry," said the diner who hoped to get away with it, "but I haven't any money to pay for that meal."

"That's all right,' said the cashier, "we'll write your name on the wall and you can pay the next time you come in."

"Don't do that. Everybody will see it."

"Oh, no they won't. Your overcoat will be hanging over it."

Mrs Brown: "I suspect my husband of having a love affair with his stenographer."

Maid: "Oh, you're just saying that to make me jealous."

Statistics show that Yale graduates have 1.3 children, while Vassar graduates have 1.7. Which only goes to show that women have more children than men.

Our linotyper says he's too broke to buy etchings, so he always asks his girl friends to come up and see the handwriting on the wall.

"How do some of the women get those expensive coats?

"The same way the minks get them."

"Old Doc Curem has given his young wife two days to live."

"Is that so?"

"Yes, he went out of town for a couple of days."

Money doesn't always bring happiness. A man with ten million dollars is no happier than a man with nine million dollars.

"So your brother's a painter, eh?"

"Yep."

"Paints houses, I presume."

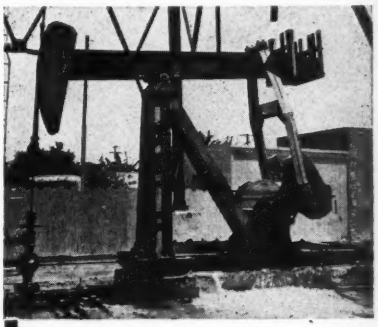
"Nope, paints men and women."

"Ooh,—an artist!"

"Nope, just paints Women on one door and Men on the other."

Three roosters in a barnyard in the rain. Two ran for the barn, and the third made a duck under the porch.

We understand that you can't kiss a girl unexpectedly; the nearest you can come to it is to kiss her before she thought you would.



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Field Development

Los Angeles Basin

Torrance Completion

Northwest from the intersection of the State Highway and Wilmington Blvd., Morton and Dolley have completed Whitelaw No. 1. On the pump the well produced an initial 166 barrels of 18 gravity oil with a cut of 24 percent. The hole was bottomed in shale at a total depth of 3730 ft. An 8⅝-inch water string was cemented at 3102 ft. and a 4¾-inch pre-gravel packed perforated liner landed at 3729 ft. South of this well the outpost being drilled by V.R.G. Wilbur has been bottomed at 3720 ft. and is running a gravel packed liner. Located southwest of the intersection of Roubidoux and Frigate the well, Ranger No. 1, has 8⅝-inch casing cemented over the Ranger zone at 3152 ft.

Getty Spuds Potrero "Cat"

Approximately one mile south of the Potrero field, J. Paul Getty has spudded his Westmore No. 1. The hole is currently being drilled ahead in sand and shale below 3800 ft. The location falls in section 2-3s-14w, about 700 ft. northwest of the J. E. Pettijohn Westmore Land Co. No. 1, which has been pumping about 20 barrels of oil per day for the past several years.

Rosecrans Completion

On the southeast corner of 128 St. and Figueroa Ave. the Union Oil Co. has recompleted Howard Park No. 27. Originally completed from the total depth of 5068 ft., the hole was plugged to 4500 ft. and the Maxwell zone gun perforated in three stages between the depths of 4340 ft. and 4485 ft. On the pump the well is producing in excess of 200 barrels per day of 31 gravity oil showing a gross cut of 35 per cent. This completion will no doubt start a small-sized boom in the town lot section of the field. Other activity in the field finds the Union Oil Co. Rosecrans No. 18 producing on the gas lift at the rate of 155 barrels per day. This well was recently deepened from the O'Dea zone to the Eighth Callender zone. Southeast from the intersection of Rosecrans and Broadway, Union's Rosecrans No. 34, is being rigged to deepen in the O'Dea zone. West of its recent extension discovery well the Shell Oil Co. is preparing to drill Bank No. 3. On the northeast corner of Redondo Beach Blvd. and Broadway the St. Anthony Oil Corp. is deepening Gordon No. 7, to the Eighth zone. P. M. Girard Russell No. 1, proposed Eighth zone test on the northeast flank of the field, is standing idle after failing in two attempts to sidetrack the old hole.

Shell Testing Extension Well

Northwest of the known producing limits of the Brea Canyon field the Shell Oil Co. is making a pumping test in Orange No. 24. Located in section 2-3s-10w, the well was bottomed at 4525 ft. after finding the top of the second zone at 3212 ft.

LOS ANGELES BASIN WILDCATS

Area	Well	No.	Section	Depth	Status
Athens	J. Paul Getty, Westmore	1	2, 3-14	3868	Drilling
Aliso Canyon	Barnsdall-Bandini Pet. Co., Roosa	1	29, 3-16	6627	Rigging pump
	Standard Oil Co., Frew	1-2	29, 3-16	9282	Coring
	Standard Oil Co., Del-Aliso	1	29, 3-16		Grade
Del Valle	Standard Oil Co., N. L. & F.	3-1	19, 4-17	7636	Redrilling
Dominguez	Cont. Expl. Co., Del-Amo	1	8, 4-13		Location
	Darling, O. F., Carson	1	35, 3-13	4263	Drilling
	Selbar Oil Co., Watson	1	17, 4-13		Rigging up
Downey	T.W.A.O. Co., Downey	10-1	4, 3-12	6867	Drilling
El Segundo	E. W. & H. R. Pauley, Loftus	1	11, 3-15	7256	Rigging pump
Elysian	Seaboard Oil Corp., Park	1	9, 1-13		Grade
Loma Verde	Shell Oil Co., Shell-Cont.	86-20	20, 5-17		Grading
Newhall	Pet. Expl. Co., Kraft	1	31, 4-15		Grade
Norwalk	Gen. Pet. Corp., Comm.	14-1	7, 3-11		Rigging up
Puente	Alleghany Pet. Corp., Rowland	1	14, 2-10		Location
	Hansen, Melvin, Corehole	3	24, 2-10	997	Drilling
Seal Beach	Gilco, Inc., Well	1	10, 5-12	960	Drilling
Sylmar	Richfield Oil Corp., T.I.T.	1	19, 3-15	8207	Prep. to test
Towsley Canyon	Haws & Ellsworth, H. E.	1	8, 3-16	100	Idle
Whittier	C.C.M.O. Co., E. Whittier Comm.	4-1	2, 3-11	6133	Abandoned
	Union Oil Co., Sansinena	14	32, 2-10	4080	Idle
	Orange County				
Buena Park	Gen. Pet. Corp., Heath	1	34, 3-11	7439	Drilling
Costa Mesa	Lovelady & Frambes, Destiny	1	9, 6-10	1550	Cleaning out
East Coyote	Barnsdall O. Co., Sunny Hills Ranch	1	22, 3-10	6754	Fishing D. P.
	San Bernardino County				
Chino Hills	Chino Hills Oil Co., Kraemer	1	33, 2-8		Prep. bld. rig
	Wm. Y. Lee, Corehole	2	21, 2-8	3005	Waiting on csg.
Soquel Canyon	A. F. McCain, Soquel	1	6, 3-8		Rigging up
	Imperial County				
Salton Sea	Pure Oil Co., State	1	26, 10-9		Rig
	Standard Oil Co., San Felipe	1	27, 11-9		Location

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A 5½-inch flow string including 1298 ft. of perforated was hung at 4508 ft. At this writing there are no figures available on the amount of fluid being produced.

Standard Drilling Up West Coyote Field

The Standard Oil Co. is currently engaged in a drilling campaign designed to fill in the undrilled portions of its holdings in this field. A total of 41 new locations have been staked on the Emery and Murphy Coyote leases. The company is presently engaged in drilling Murphy Coyote No. 136, below 5000 ft. while Murphy Coyote No. 137 is drilling below 3100 ft. Foundations have been built for Murphy Coyote No. 135, which will test the shallow gas sand in this field.

C.C.M.O. Abandons West Whittier "Cat"

Southwest of the Town of Whittier the C.C.M.O. Co. has abandoned East Whittier Comm. No. 4-1. Located in section 2-3s-11w, the hole was bottomed in hard gray sand at a total depth of 6133 ft. The well is reported to have been structurally lower than the operators first test in the area which was drilled and abandoned approximately one mile northwest of this well.

Sunny Hills "Cat" Fishing

On the Sunny Hills Ranch, northwest of the producing limits of the East Coyote field, the Barnsdall Oil Co. is fishing for drill pipe in Sunny Hills Ranch No. 1. Located in section 22-3s-10w, the hole was bottomed in gray sand and shale at the total depth of 6784 ft., after finding the top of the Stern oil zone at 6060 ft. The drill pipe was lost while cleaning out after making a successful water shut off test on 8⅝-inch casing which is cemented at 6033 ft.

G.P. Continues At Buena Park

Approximately one mile west of the town of Buena Park, the General Pet. Corp. Heath No. 1, is drilling ahead below 7500 ft. in sand and shale. The well will be drilled about 1500 ft. further before the operator will start looking for the objective upper Miocene (Puente) formation. About five miles northwest of this well, northwest of the town of Norwalk, the G.P. organization is preparing to spud in Community No. 14-1. The location of this well falls in section 7-3s-11w, and it will be the operators second well in the area having recently abandoned Allen No. 1, at a total depth of 10,360 ft.

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San Joaquin Valley

Standard Plugging Buena Vista Test

The Standard Oil Co. has plugged back its potential Miocene discovery well No. 54-27B. Located in section 27-31s-23e, the hole was bottomed in shale at 4460 ft. after finding only gray sand in the expected third oil zone. Two-formation tests were run on oil sand found in the Upper Miocene. Both tests showed strong blows with large amounts of clean oil being recovered in the drill pipe. From the results of these two tests the Standard seems assured of having discovered a new zone which may underlie a large portion of the field. The hole has now been plugged back to 4365 ft. and casing is being run to cement over the upper streak of oil sand at about 4270 ft. North of this well foundations are being built for well No. 88-27B. This location is reported as 1404 ft. south and 2279 ft. east from the northwest corner of section 27-31s-23e.

Lytle To Test Cretaceous

On section 20-20s-16e, in the Pleasant Valley field, Robert S. Lytle is drilling well No. 84-20F, in Siltstone below 9150 ft. The objective of the well is now the sands of the Eocene formation, top of which should be found within the next 500 ft. East of this well in section 21 the Standard Oil Co. has completed PVF No. 7-21F. The hole was bottomed in Hondo Siltstone at the total depth of 9130 ft. and a 7-inch water string cemented over the Eocene oil sand at 8870 ft. On the initial test the well produced 457 barrels of 29 gravity clean oil flowing thru a 9/64-inch bean with 1100 pounds tubing pressure and 1300 pounds casing pressure. The gas production was gauged at 306,000 cubic feet. Also in this section the Standard is drilling Kreyenhagen below 8300 ft. in PVF No. 5-21F.

Suisun Test Sets Casing

The Standard Oil Co. has run a perforated liner and is preparing to test Honker Comm. No. 1-A. Located on section 25-3n-1w, in the Suisun Bay area of Solano county the well has been bottomed at the total redrilled depth of 7492 ft. A 4¾-inch combination perforated liner was landed on bottom and cemented thru perforations at 7423 ft. The hole is now being cleaned out preparatory to making a production test. This has been one of the longest drilling jobs in the state for some time as it has taken the operator about 10 months to bring the well to the present stage. South of this well and in the same section the company is redrilling A. O. Stewart No. 1, at 5900 ft. Drilling conditions are apparently very bad in this area as the bit has been turning for over eight months in this well.

Tejon "Cat" Continues

In the Grapevine area, on section 19-11n-19w, the Tejon Oil Co. is sidetracking drill pipe and redrilling below 9200 ft. The hole is bottomed in Basalt at the total depth of 9340 ft., the top of the Basalt is reported to be 9074 ft.

Texas Spuds Fruitvale "Cat"

In the northwest outskirts of the town of Bakersfield The Texas Co. KCL-Fruitvale No. 1, is drilling ahead below 1000 ft. after cementing 11¾-inch surface casing at 524 ft. The hole is located 1917 ft. south and 1266 ft. east from the north ¼ corner

SAN JOAQUIN VALLEY WILDCATS

Area	Well	No.	Section	Depth	Status
	Fresno County				
Cantua	Standard Oil Co., Well	88-3	3, 17-14	3777	Drilling
Coalinga	The Texas Co., S.P.	58-21	21, 19-16	9416	Sidetracking
Kerman	Seaboard Oil Corp., S.T.	1-28	28, 14-17	5605	Drilling
Lanare	Amerada Pet. Corp., Sample	F-22-15	15, 17-18		Rigging up
Polvadero	Standard Oil Co., Bourdieu	1A	1, 21-16	10868	Cementing
Raisin City	Herndon, Sam, Well	1	13, 15-18		Location
	The Texas Co., San Joaquin	1	11, 15-17		Rigging up
	Kern County				
Antelope	Etienne Lang, Occidental	6-NW-30	30, 26-19	1300	Drilling
Bowerbank	The Texas Co., Bowerbank Unit II	8B	8, 29-24	4949	Fishing D.P
Devils Den	Priest & DeKalb, Blake	1	25, 25-18	900	Idle
Elk Hills	Capital Co., Tupman	1	24, 30-24		Location
Edison	Seaboard Oil Co., Garrison-Davis	2	30, 29-29	2359	Sampling
	Wilshire Oil Co., Cardoza	1	7, 30-29		Rigging up
Edison, SE	Judy K Oil Co., El Tejon	1	22, 30-30	2700	Drilling
Fruitvale	The Texas Co., KCL	1	26, 29-27	524	Drilling
Grapevine	Kern Line Oil Co., Well	1	19, 11-19	9340	Redrilling
	M. Metzenbaum, Well	34-3	34, 11-19		Location
Gosford	T. W. A. Oil Co., KCL	44-22	22, 30-26		Location
Jasmine	Western Gulf Oil Co., Quinn	1	8, 25-27	3241	Drilling
Kern Bluff	Standard Oil Co., Well	6-6	29, 29-29	1936	Abandoned
Kern Front	Independent Expl. Co., Austin	1	28, 28-29	2682	Drilling
Kern River	J. T. Wilcox, Zanetti	1	17, 28-28	3456	Cleaning out
McClung	Continental Oil Co., Easton	2	33, 29-26	2546	Drilling
McKittrick	Superior Oil Co., F. & W.	1	23, 29-21	1516	Completing
Midway	Std. Oil Co., Ethel D. S.	1	36, 12-24	3815	Drilling
Mt. View	DiGiorgio Fruit Corp., Well	35-10	10, 31-29		Location
	T. W. A. O. Co., Porter	24-18	18, 30-29		Rigging up
Poso Creek	Butler Bros. Oil Co., Butler	2	14, 27-27		Location
	Grandell Oil Co., Newhope	3	11, 27-27		Rig
Pyramid Hills	Pac. O. & G. Dev. Corp., C.C.&M.O.	3	17, 24-18	203	Drilling
Rio Bravo	Richfield Oil Corp., KCL-Goosloo	1	20, 29-25		Rigging up
	Union Oil Co., Kernco	88-8	8, 29-25	9450	Drilling
Rosedale	Western Gulf Oil Co., KCL-A	37-14	14, 29-26	4964	Drilling
Round Mt.	Bandini Pet. Corp., Signal Mills	5A	24, 28-28	2548	Testing
	Gen. Pet. Corp., Railroad	4	23, 28-28	2613	Prep to pump
	Signal Pet. of Calif., S. P.	1	25, 28-28	3175	Abandoned
	The Texas Co., KCL	1-13	13, 28-28		Location
	Wilshire Oil Co., Hartfield	1	32, 28-29	1090	Drilling
Shafter	T.W.A. Oil Co., Shafter Comm.	86-7	7, 28-25	11680	Fishing D.P.
So. Belridge	Bandini Pet. Co., Bacon	1	27, 28-20		Grade
Strand	Superior Oil Co., Houghton	36-35	35, 29-26	5617	Drilling
Stockdale	W.G.O. Co., KCL	77-5	5, 30-27		Rig
Tejon	Richfield Oil Corp., Tejon	B-23-6	6, 11-18	1759	Drilling
	Richfield Oil Corp., Tejon	B-14-36	36, 11-19	1828	Drilling
Temblor	B. F. Delanty, Well	69-A-1A	36, 29-20	306	Drilling
10 Section	Ohio Oil Co., KCL	J-1	6, 31-26	8750	Drilling
	Madera County				
Herminghaus	The Texas Co., Gill	41-17	17, 13-16		Location
Firebaugh	The Texas Co., Moffat	55-7	7, 12-15		Rig
	Tulare County				
Kingsburg	Amerada Pet. Corp., Dinuba	20-1	20, 16-24	1231	Abandoned
	Amerada Pet. Corp., Dinuba	29-2	29, 16-24		Rigging up

of section 26-29s-27e, approximately ¼ mile east of the southeasterly producing limits of the Fruitvale field. The well will test the Chanac and Santa Margarita sections and will explore to about 5000 ft.

Fresno "Cat" Redrilling

Two miles east of the Northeast Coalinga Eocene field The Texas Co. S. P. No. 58-21, is redrilling and sidetracking drill pipe at 9370 ft. Located in section 21-19s-16e, the hole is bottomed at 9416 ft. where the drill pipe was stuck when the boilers blew up about the middle of last January.

Superior Completes Coalinga Eocene Well

In section 6-20s-16e, The Superior Oil Co. Cagle No. B-12, has been completed for an initial production of 1464 barrels per day. The hole was bottomed in oil sand at the total depth of 8198 ft. A string of 7⅝-inch casing was cemented at 7558 ft. and a 5½-inch liner including 651 ft. perforated landed at 8198 ft. The initial rate was made thru a 28/64-inch bean with 580 pounds flow pressure. At present the well is flowing 216 barrels per day of 28 gravity clean oil thru a 12/64-inch bean with 640 pounds flow pressure. A check of other activity in the field shows the Standard Oil Co. to be drilling two wells on section 19-20s-16e. Well No. 64-19F, is drilling ahead below 1000 ft. after cementing 11¾-inch surface casing at 603 ft., while Well No. 84-19F is drilling Kreyenhagen shale below 6900 ft.

Standard Spuds Deep Test

In the Midway Sunset field, north of the town of Maricopa, the Standard Oil Co. has spudded in on Ethel D. S. No. 1. Located in section 36-12n-24w, the hole is currently being drilled in sand and shale below 3800 ft. after cementing 13⅜ surface casing at 1750 ft. The try is expected to go to at least 15,000 ft. and may prove to be the deepest well in the world. That record is now held by the Continental Oil Co. KCL No. A-2, which was drilled to 15,004 ft. and is now producing from about 12,000 ft. The company is using the largest and heaviest drilling equipment available, termed "Mr. Big." The well will explore below the Etchegoin producing zones probably into the Eocene formation.

Amerada Continuing At Kingsburg

In the Kingsburg-Lanare area of Fresno county the Amerada Pet. Co., is continuing with its core hole program. On section 20-16s-24e, Dinuba Comm. No. 20-1, has been abandoned in Granite at the total depth of 1231 ft. The hole was drilled and abandoned in four days elapsed time. On section 22-16n-24e, location is being prepared for Dinuba Comm. No. 22-1. Southwest of this well, in section 29, Dinuba Comm. No. 29-2 is preparing to spud. North of the Lanare field this operator is rigging up on Sample No. F-22-15. The location falls in the northwest ¼ of section 15-17s-18e, approximately ½-mile north of the Superior Oil Co's. producer in the Lanare field.

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Superior Stakes Woodland "Cat"

Approximately three miles southeast of the Woodland gas field the Superior Oil Co. has staked location for Oeste No. 1. The try is located 300 ft. north and 330 ft. west from the east ¼ corner of section 10-8n-1e, about 5 miles west of the town of Davis. The hole will be drilled into Cretaceous rocks in search of the gas sand now being produced in the Woodland gas field.

Richfield Stakes Wildcat

Southwest of the West Cat Canyon field, the Richfield Oil Corp. has staked location for Los Flores No. 1. The location is reported to be 2564 ft. north and 2090 ft. west from the southeast corner of the Los Flores Land and Oil Co. property. This location falls in projected section 10-8n-33w. The objective depth of the hole will be something over 8000 ft.

Fillmore "Cat" Continuing

Northwest of the town of Fillmore, on section 24-4n-20w, the Standard Oil Co. continues to drill ahead in Fillmore Comm. No. 2-1. With the operator withholding all information as to the section being penetrated, the well is now drilling ahead below 12,700 ft.

Signal Active At Elwood

The Signal Oil and Gas Co. has spudded Appleford No. 98-10, and is now drilling ahead below 500 ft. The hole is located on the pier in section 16-4n-29w, approximately 26 ft. west of well No. 98-6. The objective of the well is the sands of the Vaqueros formation. Northwest of the producing limits of the field the operator is grading location and roads for the new state tidelands well called State No. 129-1.

Richfield Coring

The Richfield Oil Corp. is drilling ahead and taking spot cores below 2000 ft. in Gallatin No. 1. Located on section 26-25n-3w, in the Corning area of Tehama county, the well has found hard going below 1600 ft. Intermittent streaks of shale and Basalt have been cored below that depth.

Shiells Canyon Extension

Approximately 330 ft. south of its recently completed extension well the Los Nietos Co. is preparing to drill Elkins No. 2-2. This will be this operator's second well west of the producing limits of the Shiells Canyon Field. The recently completed Elkins No. 2-1, is currently pumping 133 barrels per day of 33 gravity clean oil. Both of the above wells are located in section 5-3n-19w. To the east, but still in this same section, The Texas Co. has staked location for Hammon No. 1. Still farther to the east, in section 4, the operator is preparing to place Shiells No. 146 on production from the total depth of 2700 ft. During the past month the known producing limits of the field have been extended over ½-mile to the west.

Standard Spuds Holser Canyon Test

Approximately ½-mile south of the Holser Canyon field the Standard Oil Co. Bowman No. 2-1, is drilling ahead below 500 ft. Located in section 14-4n-18w, the objective depth of the well is approximately 8000 ft.

Richfield Grading

The Richfield Oil Corp. is grading location for Escolle No. 1. The final location of the well is 660 ft. south and 600 ft. east from the northwest corner of the Escolle property. This location falls in projected section 20-9n-34w. The well is being drilled as a deep test of the Casmalia field and has 5000 ft. as the objective depth.

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COASTAL COUNTIES WILDCATS

Area	Well	No.	Section	Depth	Status
	Santa Barbara County				
Cat Canyon	Richfield Oil Corp., Los Flores	1	10, 8-33		Location
E. Cat Canyon	Union Oil Co., McNee, C. H.	1	20, 9-32		Rigging up
Lompoc	S. R. Williams, Fickert	1	8, 7-33	2850	Drilling
Los Alamos	J. I. Anderson & Co., So. Calif. Pet. Corp., Archambeault	1	3, 7-32		Rigging up
	Ventura County				
Camarillo	Camarillo Oil Co., Camarillo	2	32, 2-20	2647	Testing
	Jos. Schuck, Schuck	1	28, 2-20	952	Idle
Fillmore	Standard O. Co., Fillmore Comm.	2-1	24, 4-20	12705	Drilling
Oxnard	Exeter Oil Co., Ltd., Lennox	2	6, 1-21	2812	Idle
	Hub City Pet. Co., Chase	1	6, 1-21	1955	Idle
Piru	Delroy Pet. Corp., Lisk	3	22, 5-18	2808	Prep. to deep'n
	Standard Oil Co., Bowman	2-1	14, 4-18	293	Drilling
Santa Paula	J. J. Stevens, Corehole	1	31, 4-20	2969	Idle
Sespe	Volunteer Pet. Co., Tar Creek	3	28, 5-19	2064	Drilling
Shiells Canyon	Los Nietos Co., Elkins	2-2	5, 3-19		Location
South Mt.	Cambria Oil Co., Well	1	13, 3-21		Location
	F. E. Fairfield, S. M.	1	19, 3-20	4991	Bailing
	Wilshire Oil Co., Petit	1	9, 3-20		Foundation
Timber Canyon	Geo. H. Roberts, O'Leary	1	29, 4-20	380	Idle

NORTHERN COUNTIES WILDCATS

County	Well	No.	Section	Depth	Status
Butte	Richfield Oil Corp., Dayton	2-1	6, 21n-1e	1891	Drilling
Humboldt	Br.Am.O.Prod.Co., Mitchell-Dorr	1	10, 3n-1w	504	Drilling
San Joaquin	Richfield Oil Corp., East Stockton	2	6, 1n-9e		Rigging up
San Luis Obispo	Los Nietos Co., Scott	2	5, 32s-13e	2177	Drilling
	McDuffie, Wm. C., Dollie	2	31, 31s-13e	1287	Rigging pump
Solano	Honolulu-Barnsdall O. Co's., Liberty Farms	1	18,5n-5e		Prep. to spud
	Standard Oil Co., Honker Comm.	1A	25, 3n-1w	8304	Cleaning out
	Standard Oil Co., A. O. Stewart	1	25, 3n-1w	8728	Sidetracking
	Richfield Oil Corp., Gallatin	1	26, 25n-3w	1908	Drilling
Yolo	Superior Oil Co., Oeste	1	10, 8n-1e		Prep. to spud